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COMPARISON BEST VIDEO CONFERENCE FOR LEARNING AND TEACHING ACTIVITIES USING ANALYTIC HIERARHICAL PROCESS

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Abstract

During the pandemic, almost all industries have been disrupted, including the education industry. To support the sustainability of the education industry, many institutions use various video conferencing platforms. There are six aspects that need to be considered in choosing a video conference platform: Features provided, Ease of use, security level, bandwidth usage, platform stability and the ability to accommodate the number of participants in a conference room. This study shows how to prioritize these aspects in choosing a video conferencing platform carried out by educational institutions in Indonesia. The method used in this research is the Analytical Hierarchical Process (AHP). And the results of this study show the order of aspects in choosing a video conferencing platform for teaching and learning needs.

Keywords: *Analytical Hierarchical Process, Decision making, Video Conference, Teaching Activities*.

1. INTRODUCTION (huruf besar, 10pt, tebal)

Video conferencing can make people who are hindered by distance meet face to face virtually and make it possible to interact visually and audio. Where the interaction is needed in the teaching and learning process. Using various kind of different technologies to improve teaching in uncertain environment [1]. Because there are so many video conference platforms that are spread out, it is necessary to pay attention to aspects that affect the sustainability of using the video conference platform in its selection. Here are some of the most influential aspects:

A. Features

Features or functions provided by the platform to facilitate users such as screen sharing, board, raise hand, chat and record. Experiential teaching and learning promises to bridge the gap between academic disciplines and the practices that they inform [2]. Completeness of features can affect the smooth teaching and learning process. There are pros and cons for each in terms of technical requirements and features [3].

B. Easy to Use

The ease of accessing and utilizing the features provided, the placement of menus and features that are easily accessible will increase user comfort. The complete features will not be able to be enjoyed by users if it is difficult to use. Easy to use also commonly said as a user friendly program and the goal is to provide good user experience [4].

C. Security

Platform security in maintaining privacy, data and avoiding the intrusion of uninvited participants. Enforcing appropriate security and privacy settings prevents attackers from exploiting the system [5]. The popularity of telecommuting and video conferencing applications has also opened up potential avenues for cyber-attacks and other hostile hacking incidents that target porous networks and unsafe systems and applications, thereby raising serious ethical, cyber security and privacy concerns [6].The technical relevance implies that technology is not only an element of data protection law, but also a tool to enforce it [7].

D. Bandwidth Usage

The bandwidth needed to run video conferencing smoothly, so there's no lost sound or video lags. More participants means more video and sound that must be sent between participants, so good compression technology is needed so that the size of data communication can be more efficient.

Implementation of videoconference service in the global network is challenging because it's difficult to maintain quality of all network segments, which is utilized during the communication process [8]. So that the bandwidth usage of each platform msust be considered to match the characteristics of the network it has.

E. Stability

Platform stability during video conferencing, minimal errors and compatibility with various operating systems. The occurrence of system failure

in the middle of the video conference process will certainly disturb the user's comfort.

F. Participant Limit

Platform capability to handle multiple participants in video conferencing. Because video systems require greater channel bandwidth for video transmission, even for two participants, that support multiuser video conferencing is extremely challenging task [9].

2. METHODS

This method is a multiple decision making method that models decision making processes mathematically and are used to solve complex problems [10]. In this study we use the Analytic Hierarhical Process (AHP) methodology and divide it into several stages as explained below:

2.1 Problem Decomposition

Due to the large numbers of video conferencing platforms available, causing confusion among teachers who need them to use as teaching tools. We tried to ask some teachers who often use video conferencing media as teaching and learning media. This is necessary to know the needs and important factors in using video conferencing as a teaching and learning tool. The basic aspects needed by teaching staff in using the platform are determined, as follows:

1) Features
2) Easy to Use
3) Platform security
4) Bandwidth usage
5) Platform stability
6) Participant limit

2.2 Alternative Selection as Strategic Scenarios

In this step, we invite academic experts to discuss determining the choice of the most suitable platforms to use. Through in-depth discussions that began with a brainstorming process, it was agreed that five alternative platforms should be selected as priority based on their level of popularity and user population. The five platforms are:

1) Alternative A : Zoom Meeting

Platform Video Conferencing, Cloud Phone, Webinars and Chat. During the Covid-19 pandemic, Zoom was the choice for many government agencies, universities, non-profit organizations, and individuals [11].

2) Alternative B : Google Meet

A video-communication service developed by Google. Google Meet is considered as a safe environment in online teaching, and it is highly recommended during the outbreak. It is considered as a potential solution in teaching during the shutdown period [12].

3) Alternative C : Microsoft Team

A proprietary business communication platform developed by Microsoft, as part of the Microsoft 365 family of products. Microsoft Teams applications can easily be downloaded through desktop and mobile applications, and its features are exploited by people everywhere. Microsoft Teams provides better features like other social media covering chat rooms, collaborative discussion, content sharing, and video conferencing [13].

4) Alternative D : Webex

The leading enterprise solution for video conferencing, online meetings, screen share, and webinars. It allows the user with the feature of creating secure virtual work places for short term projects to solving long term problems [14].

5) Alternative E : BigBlueButton

A software web conferencing system for Linux servers. Its intended use is online learning. BigBlueButton is an open source synchronous tool, which has proven to be an effective alternative in educational processes, since it gives rise to virtual spaces for real-time communication where students, the advisor and students can exchange information through a videoconference, chat, whiteboard, as well as file sharing, thus generating a teaching-learning process remotely [15].

From the decomposition results above, the structure of the AHP tree can be described as follows:

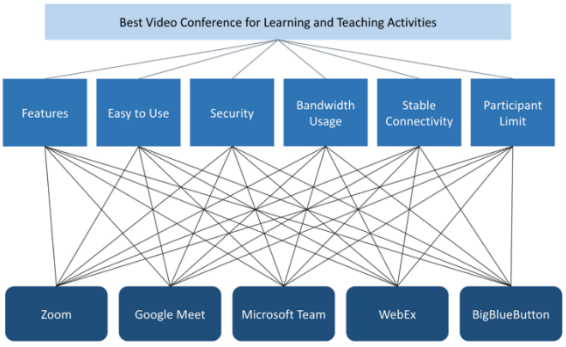


Figure 1. AHP Tree Structure

2.3 Elements Assessment and Weighting

Each aspect is assessed and given a weight by comparing it to other aspects. In determining the assessment and weighting, a standard scheme is used as shown in table 1. The results of the comparison between all aspects are presented in Figure 2. In this study, we invite several teaching staff and experts to participate in giving the assessment.

Table 1. Assesment and Wighting Score Range

Score	Meaning
1	Equally
2	Equally to moderately
3	Moderately
4	Moderately to strongly
5	Strongly
6	Strongly to very strongly
7	Very strongly
8	Very strongly to extremely strongly
9	Extremely strongly

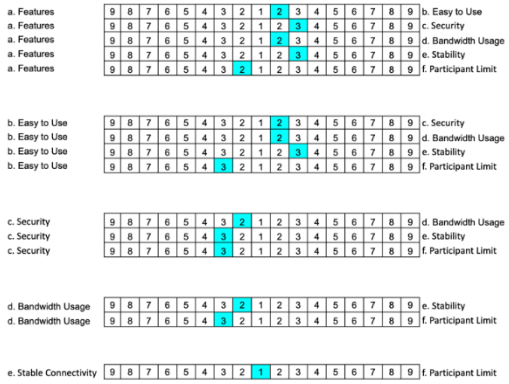


Figure 2. Weight Distribution.

3. RESULT

3.1. The Matrix Consistency Test

After the weighting and assessment have been determined, then a decision matrix is made. Based on these data, the Eigen values, Maximum Lambda, Consistency Index (CI), Ratio Index, and Consistency Ratio (CR) were calculated. Figure 3 shows the maximum lambda formula, Figure 4 shows the Consistency Index formula, and Figure 5 shows the Consistency Ratio formula.

The criteria used in this case are 6 criteria, so the constant value used is 1.24. The calculation results show that the Consistency Ratio obtained is below 0.10 or below 10%, so the calculation is included in the consistent category. The calculation of the consistency test is presented in Figure 6.

$$\lambda maksi\mu m = \left(\sum GM_{11-n1} \times \bar{x}1\right) + \ldots + \left(\sum GM_{1n-n1} \times \bar{x}n\right)$$

Figure 3. Maximum Lambda Formula

$\lambda maksimum$ = Maximum Lambda

$(\Sigma GM11 - n1 \times n1)$ = The total result of the sum of criteria 1 multiplied by the results of the Eigen Value criteria 1.

To define the maximum lambda is to multiply the total result of the sum of criteria 1 with the eigen values of criteria 1 then add the results of the number of criteria 2 multiplied by the eigen values of criterion 2 and so on until it reaches criteria 6.

$$CI = \frac{\lambda maksimum - n}{n - 1}$$

Figure 4. Consistency Index Formula

CI = Consistency Index

$\lambda maksimum - n$ = Maximum Lambda minus to total number of criterias

$n - 1$ = Total number of criterias – 1

To define Consistency Index is Maximum Lambda minus total number of criteria then divided by total number of criterias minus 1. As seen in Figure 6 is 6.143-6 then divided by 6-1.

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

Figure 5. Consistency Ratio Formula

CR = Consistency Ratio

CI = Criteria Index

RI = Random Index

To define Consistency Ratio is Criteria Index divided by Random Index. As seen in Figure 6 the consistensy index is 0.029 divided by the Random Index, the criteria used in this case are 6 criteria, so the constant value used is 1.24.

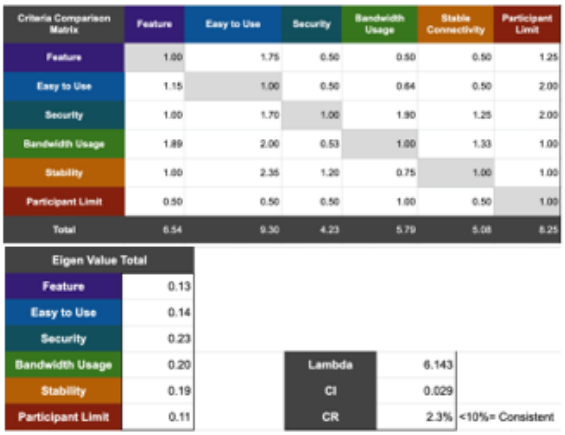


Figure 6. Consistency Test

3.2. Priority Determination

After testing the consistency and it was found that the CR is below 0.1 which indicates that the test results are consistent, then the final results show the order of priority as follows:

Criteria	Weight	Rank
Feature	13.31%	5
Easy to Use	13.71%	4
Security	23.23%	1
Bandwidth Usage	19.70%	2
Stability	19.44%	3
Participant Limit	10.61%	6

Figure 7. Priority Rank

3.3. The Final Decision

At this stage a table is developed to map the five alternatives combined with all aspects of the criteria. Then with the help of experts determined the weights and scores on each relationship between alternatives and criteria. The lowest score is 1 if the alternative does not meet the associated criteria and the maximum score is 9 for the alternative that perfectly meets the criteria. The following table of assessment results:

Feature Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlue Button
Zoom	1.00	1.00	2.00	2.00	3.00
Google Meet	1.00	1.00	0.50	0.50	1.00
Microsoft Teams	0.50	2.00	1.00	2.00	2.00
WebEx	0.50	2.00	0.50	1.00	2.00
BigBlueButton	0.33	1.00	0.50	0.50	1.00
Total	3.33	7.00	4.50	6.00	9.00

Weight	Rank
31.23%	1
14.88%	4
24.40%	2
18.57%	3
10.91%	5

Eigen Value Total	
Zoom	0.3109
Google Meet	0.1497
Microsoft Teams	0.2427
WebEx	0.1872
BigBlueBut ton	0.1095

Lambda	5.276
CI	0.069
CR	6.2% <10%= Consistent

Figure 8. Features Weighting Matrix

Easy to Use Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlue Button
Zoom	1.00	0.50	2.00	2.00	3.00
Google Meet	2.00	1.00	2.00	3.00	3.00
Microsoft Teams	0.50	0.50	1.00	1.00	1.00
WebEx	0.50	0.33	1.00	1.00	2.00
BigBlueButton	0.33	0.33	1.00	0.50	1.00
Total	4.33	2.66	7.00	7.50	10.00

Weight	Rank
25.4%	2
36.8%	1
13.5%	4
14.3%	3
10.0%	5

Eigen Value Total	
Zoom	0.2543
Google Meet	0.3647
Microsoft Teams	0.1359
WebEx	0.1431
BigBlueBut ton	0.1020

Lambda	5.098
CI	0.025
CR	2.2% <10%= Consistent

Figure 9. Easy to Use Comparison Matrix

Security Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlue Button
Zoom	1.00	2.00	0.50	0.50	1.50
Google Meet	0.50	1.00	1.00	1.00	0.50
Microsoft Teams	2.00	1.00	1.00	1.00	2.00
WebEx	2.00	1.00	1.00	1.00	1.00
BigBlueButton	0.50	2.00	0.50	1.00	1.00
Total	6.00	7.00	4.00	4.50	6.00

Weight	Rank
18.9%	3
15.4%	5
25.7%	1
22.4%	2
17.6%	4

Eigen Value Total	
Zoom	0.1877
Google Meet	0.1563
Microsoft Teams	0.2563
WebEx	0.2230
BigBlueBut ton	0.1766

Lambda	5.303
CI	0.076
CR	6.7% <10%= Consistent

Figure 10. Security Comparison Matrix

Bandwidth Usage Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlu Buttor
Zoom	1.00	0.50	2.00	2.00	2.0
Google Meet	2.00	1.00	2.00	2.00	2.0
Microsoft Teams	0.50	0.50	1.00	2.00	0.5
WebEx	0.50	0.50	0.50	1.00	0.5
BigBlueButton	0.50	0.50	2.00	2.00	1.0
Total	4.50	3.00	7.50	9.00	6.0

Weight	Rank
24.5%	2
32.3%	1
14.1%	4
10.7%	5
18.5%	3

Eigen Value Total	
Zoom	0.2422
Google Meet	0.3200
Microsoft Teams	0.1433
WebEx	0.1078
BigBlueBut ton	0.1867

Lambda	5.195
CI	0.049
CR	4.3% <10%= Consiste

Figure 11. Bandwidth Usage Comparison Matrix

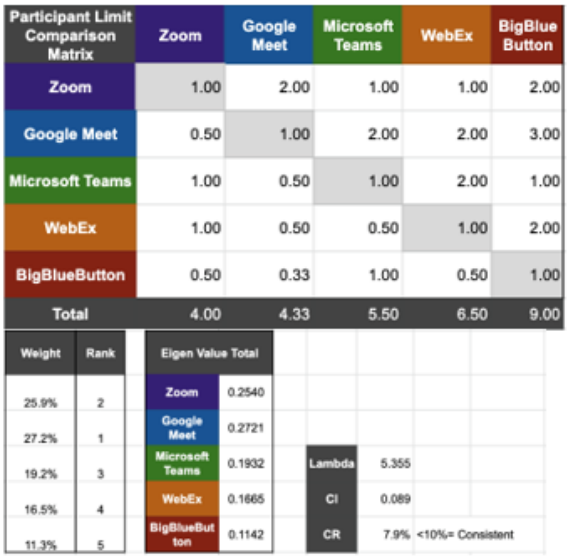
Stability Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlue Button
Zoom	1.00	1.00	2.00	2.00	2.00
Google Meet	1.00	1.00	2.00	1.00	2.00
Microsoft Teams	0.50	0.50	1.00	1.00	2.00
WebEx	0.50	1.00	1.00	1.00	2.00
BigBlueButton	0.50	0.50	0.50	0.50	1.00
Total	3.50	4.00	6.50	5.50	9.00

Weight	Rank
28.7%	1
25.0%	2
16.5%	4
18.9%	3
10.9%	5

Eigen Value Total	
Zoom	0.2859
Google Meet	0.2495
Microsoft Teams	0.1651
WebEx	0.1901
BigBlueBut ton	0.1094

Lambda	5.097
CI	0.024
CR	2.1% <10%= Consistent

Figure 12. Stability Comparison Matrix



Participant Limit Comparison Matrix	Zoom	Google Meet	Microsoft Teams	WebEx	BigBlue Button
Zoom	1.00	2.00	1.00	1.00	2.00
Google Meet	0.50	1.00	2.00	2.00	3.00
Microsoft Teams	1.00	0.50	1.00	2.00	1.00
WebEx	1.00	0.50	0.50	1.00	2.00
BigBlueButton	0.50	0.33	1.00	0.50	1.00
Total	4.00	4.33	5.50	6.50	9.00

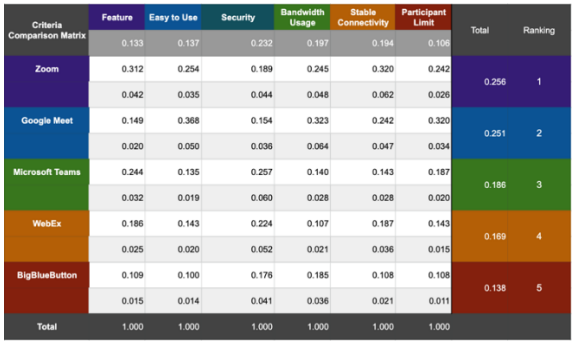
Weight	Rank
25.9%	2
27.2%	1
19.2%	3
16.5%	4
11.3%	5

Eigen Value Total	
Zoom	0.2540
Google Meet	0.2721
Microsoft Teams	0.1932
WebEx	0.1665
BigBlueBut ton	0.1142

Lambda	5.355
CI	0.089
CR	7.9% <10%= Consistent

Figure 13. Participant Limit Comparison Matrix

Furthermore, the results of each assessment are multiplied by the weight of each criterion. The final result will show the alternatives that best meet the criteria to those that do not meet the criteria. Bellow is table detail final result :



Criteria Comparison Matrix	Feature	Easy to Use	Security	Bandwidth Usage	Stable Connectivity	Participant Limit	Total	Ranking
	0.133	0.137	0.232	0.197	0.194	0.106		
Zoom	0.312	0.254	0.189	0.245	0.320	0.242	0.256	1
	0.042	0.035	0.044	0.048	0.062	0.026		
Google Meet	0.149	0.368	0.154	0.323	0.242	0.320	0.251	2
	0.020	0.050	0.036	0.064	0.047	0.034		
Microsoft Teams	0.244	0.135	0.257	0.140	0.143	0.187	0.186	3
	0.032	0.019	0.060	0.028	0.028	0.020		
WebEx	0.186	0.143	0.224	0.107	0.187	0.143	0.169	4
	0.025	0.020	0.052	0.021	0.036	0.015		
BigBlueButton	0.109	0.100	0.176	0.185	0.108	0.108	0.138	5
	0.015	0.014	0.041	0.036	0.021	0.011		
Total	1.000	1.000	1.000	1.000	1.000	1.000		

Figure 14. Final Weighting and Scoring

From the calculation of the final score, it can be obtained the priority choice of alternatives that need to be selected for best video conference use for learning and teaching. The priority order that can be used as a benchmark for decision making is as follows:

- Priority 1 is Alternative A, Zoom with total score = 0.256.
- Priority 2 is Alternative B, Google Meet with total score = 0.251.
- Priority 3 is Alternative C, Microsoft Teams with total score = 0.186.
- Priority 4 is Alternative D, WebEx with total score = 0.169.
- Priority 5 is Alternative E, BigBlueButton with total score = 0.138.

4. CONCLUSION

From the results of this study it was found that the most important criteria are security then bandwidth usage, stability, ease of use and the last is features.

Security has an important place in using video conferencing where the implementation of learning activities must take place safely and comfortably without any disturbance or interruption from other parties who are not interested. Followed by the second place with the use of bandwidth because bandwidth needs will have an impact on the quota that will be used. Then in the third place the connection stability is to minimize disturbances during the teaching and learning process. The fourth place is easy to use, the ease of use of teaching and learning from the layout of the menu navigation, features and user interface and user experience makes users more comfortable in using. The fifth place is Feature, it cannot be denied that the features provided are important in the teaching and learning process such as screen sharing, recording, chat and other supporting features. The sixth place is no less important, namely the participation limit of participants where a video conference tool can accommodate a large number of participants in a class.

While the alternative that best meets the criteria is Zoom, next is Google Meet, Microsoft Team, Webex and the last is the BigBlueButton. The detailed score has been presented in Figure 13. Teachers are advised to use the Zoom video conferencing platform because they best meet the required criteria. But if you don't like use zoom as your teaching or learning video conference tools, you can try others platforms in sequence according to the following priority levels :

Table 2. Video Conference Platform Priority

Priority Level	Platform
1	Zoom
2	Google Meet
3	Microsoft Team
4	WebEx
5	BigBlueButton

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