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Selection the Best Quiz Applications as Learning Performance Evaluation Media Using the Analytical Hierarchical Process Method

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***Abstract*—The existence of the Covid-19 pandemic requires the whole world to limit activities outside the home, including in the world of education that uses a learning system from home. To facilitate learning activities, relevant media are needed, currently there are many recommendations for quiz applications with various interesting features. In this study, analysis and comparison was carried out with the most widely used quiz applications such as Kahoot, Quizizz, Mentimeter, Quizlet, and Educandy based on the features available on the selected quiz application. Able to study and evaluate the availability of quiz tool features which are divided into 3 subcategories: question features, results and feedback features and quiz settings features. In addition to these features, we can change the quiz method in class which was initially less interactive to be more interesting with the game application feature in it and can spur student achievement in today's era.**

Keywords—learning media, analytical hierarchical process, quiz application

I. Introduction

After the official announcement of the determination of the global Covid-19 pandemic by the World Health Organization (WHO), countries in the world, including Indonesia, set a policy of physical restriction by *work from home* and staying at home as an effort to prevent the spread of Covid-19. In response to this policy, the Ministry of Education and Culture of the Republic of Indonesia through Circular Number 2 of 2020 concerning Prevention and Handling of Covid-19 within the Ministry of Education and Culture of the Republic of Indonesia and Circular Letter Number 3 of 2020 concerning Prevention of Covid-19 in Education Units appealed to educational institutions postpone activities that gather large numbers of people or activities outside of school. Several points in the circular letter are in the form of an obligation for educational staff to combine learning methods asynchronously through various learning management systems so that they are more interactive so that students do not feel bored in learning. Online learning activities have been going on for approximately one year through various learning platforms.

In universities, the number of online learning platforms that can be used for learning activities creates a preference for students. The use of online learning platforms in learning activities is an effort to make learning more fun and not monotonous. From several platforms on the internet[1], we conducted a survey of users of the Kahoot, Quizizz, Mentimeter, Quizlet, and Educandy applications. The five applications were then analyzed using the *Analytical Hierarchical Process* (AHP) with the criteria of Security, Easy to Use, Features, Stable Connectivity, Results and feedback to identify which quiz application was the best. The benefit of this research is that it makes online learning methods less boring and easier for teachers and students to accept. Through the results of this study, it can be seen the preferences of students' interests in using the quiz learning platform so that it can spur student learning performance to be more active and interactive.

II. Material and Methods

This research consists of three (3) levels, the specifications of which can be seen in Figure 1. The first level is Goals, namely Selecting the best quiz application features as learning performance evaluation media. The selection of criteria aims to determine the effective learning performance evaluation media method for students.

At level two is an element consisting of five (5) criteria, namely Security, Easy to Use, Features, Stable Connectivity, Results and feedback. These five criteria are important elements in determining the best quiz application that can be accepted by teachers and students.

The third level is an alternative action taken to facilitate the online teaching system program using Kahoot, Quizizz, Mentimeter, Quizlet, and Educandy.

This research uses AHP (Analytical Hierarchy Process) calculation method. AHP is a decision support method developed by Thomas L. Saaty. This decision support method will describe a complex multifactor or multicriteria problem into a hierarchy.

A. Definition of Analytical Hierarchy Process

Analytical Hierarchy Process The Analytical Hierarchy Process was developed by Thomas L. Saaty from Wharston Business School to find a ranking or priority order of various alternatives in solving a problem[2]. In everyday life, we are always faced with choices from various alternatives. Therefore, it is necessary to determine priorities and test the consistency of the choices that have been made. In a complex situation, decision making is not influenced by one factor alone but is multifactorial and includes various levels and interests.

The assessment can be presented in the form of a matrix called a pairwise comparison matrix, which is a pairwise comparison matrix that contains the preference levels of several alternatives for criteria. The preference scale with a scale of 1 shows the lowest level to the highest level of 9 scale.

Table 1. AHP Rating Table

Score	Meaning
1	Both elements are equally important
3	One element is slightly more important than the other elemen
5	One element is more important than the other elements
7	One element is clearly more absolutely important than the other elements, One element that is strongly supported and dominant is seen in practice
9	One element is absolutely important than the other, The evidence in favor of one element against another has the highest possible level of affirmation to corroborate.
2,4,6,8	Values between two values of adjacent considerations, This value is given when there are two compromises between 2 choices

Based on research conducted by Andri [9] and Ellya Sestri [10], the basic principles that must be understood in solving problems using AHP are as follows.

1. *Decomposition*

The definition of decomposition is solving or dividing a complete problem into its elements into a hierarchical form of decision-making process. Each element or elements in the hierarchy are interconnected. Figure 1 shows the hierarchical structure of AHP.

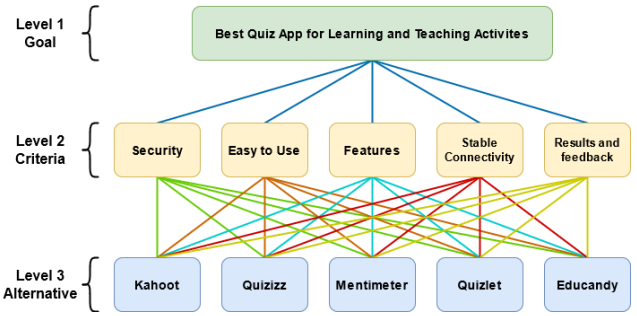

Figure 1. Hierarki AHP

2. *Comparative Judgement*

The criteria and alternatives were carried out by pairwise comparisons, for various reasons, a scale of 1 to 9 was the best scale for expressing opinions. The value and definition of qualitative opinion from the comparison scale can be measured using an analysis table. In assessing the relative importance of two elements, the reciprocal axiom applies, meaning that if element i is considered 3x more important than j, then element j must be equal to 1/3x as important as element i. In addition, the comparison of two equal elements will result in the number 1, meaning that it is equally important.

3. *Synthesis of priority*

For each criterion and alternative, it is necessary to do pairwise comparisons. Relative comparison values of all alternative criteria can be adjusted according to predetermined judgments to produce weights and priorities. Weights and priorities are calculated by manipulating matrices or by solving mathematical equations.

4. *Logical Consistency*

Consistency has two meanings, first, similar objects can be grouped according to uniformity and relevance. Second, it concerns the level of relationship between objects based on certain criteria.

The AHP analysis method has advantages and disadvantages in its analysis system [8].

1. The advantages of the AHP analysis method are as follows.
    - Unity (unity) AHP makes broad and unstructured problems into a model that is flexible and easy to understand.
    - Complexity AHP solves complex problems through a systems approach and deductive integration.
    - Interdependence (interdependence) AHP can be used on system elements that are independent of each other and do not require a linear relationship.
    - Hierarchy structuring AHP represents natural thinking that tends to group system elements into different levels, each level containing similar elements.
    - Measurements AHP provides a scale of measurement and methods for obtaining priorities.

- AHP synthesis refers to an overall estimate of how desirable each alternative is.
- Trade Off AHP considers the relative priority of the factors in the system so that people are able to choose the best alternative based on their goals.
- Judgment and consensus AHP does not require a consensus, but combines the results of different assessments.
- Process repetition AHP is able to make people filter the definition of a problem and develop their judgment and understanding through the repetition process.

2. While the weaknesses of the AHP method are as follows.
   - The dependence of the AHP model on its main input. The main input is the perception of an expert so that it involves the subjectivity of the expert. In addition, the model becomes meaningless if the expert gives an erroneous assessment.
   - The AHP method is only a mathematical method without statistical testing so that there is no confidence limit for the correctness of the model formed.

B. Definition of Instructional Media

Learning media is one of the important things in learning. Learning media is a place for learning messages to be conveyed with the aim of achieving the learning process [3]. One of the success factors in learning is the quality of learning media as a forum for delivering learning messages from learning sources or sources of information to recipients. This cannot be separated from the role of educators. The competence of educators in providing teaching to students is one of the crucial things in learning. Therefore, learning media must continue to be developed in the future with effective and efficient models and media.[4]

C. Definition of Quiz Application

The quiz app is a formative assessment tool that works on all devices (computers, tablets, smartphones) with iOS, Android and Chrome apps. Users need a single device, but do not need to create an account in the app. Users can immediately join by entering the game code.[5] Quizzes can be shared via links for others to use. The quiz app uses fun elements such as memes, avatars, and gamification that keep students excited about learning. The quiz application can also display detailed performance analysis data of each participant, online, and can be downloaded as a learning report [5]. For formative evaluation, the quiz application informs and identifies wrong answers and correct answers for each learner, making it more effective because it is known what material needs to be improved.[6] Learning for millennials using quiz applications is proven to increase learning competencies in an interesting and collaborative way in accordance with learner-centered learning [7].

III. Research Methodology

In this study, the method used is the Analytical Hierarchy Process which is implemented to assist educators in choosing the best quiz application based on several assessment criteria and alternatives provided. This study performs calculations using an online Analytical Hierarchy Process (AHP) application.

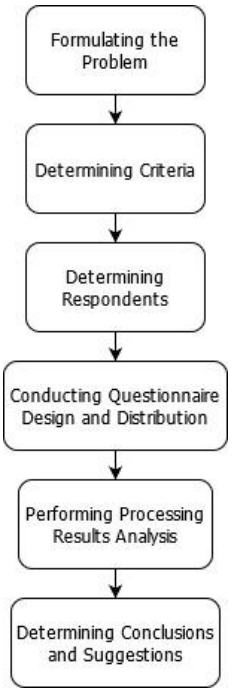

Figure 2. Determining AHP

The stages of research are guidelines in conducting the research process, so that the research carried out can run well and systematically. The stages of research used in this study can be seen in Figure 2.

Based on Figure 2, before getting the right decision, the first step in this research is to determine several criteria seen from several things that are important points in carrying out quiz activities when online learning takes place. These criteria consist of security, ease of use, features contained in the application, a stable connection when used, as well as results and feedback. After that, a value is given according to the criteria consisting of 1 to 9. Where 1 is equally important to 9 which shows it is very important in comparing one criterion with another. After that, the calculation of the comparison criteria is automatically carried out. The final step is to analyze the results based on the rankings that appear.

IV. Result

A. Determining Criteria

Based on the research framework described in the previous chapter, the next process is the design of a hierarchical structure. The purpose of this research is to implement the Analytical Hierarchy Process (AHP) method so that it can determine the best quiz application. The alternatives determined in this study are five applications that are widely used to support online learning. The five applications are Kahoot, Quizizz, Mentimeter, Quizlet, and Educandy. Meanwhile, the criteria in the hierarchical structure are determined from the important factors of an application.

The selection of the best application uses several criteria to determine a decision, namely: security, ease of use, features, stability of connectivity, as well as results and feedback.

B. Determining Respondents

Respondents in this study were required to determine the value of the weight of each criterion and alternative. AHP is not too concerned with the number of respondents as a source of input, but instead attaches great importance to the quality of the input values from the respondents. Therefore, respondents involved in this study must understand, understand, have experience, and have used the five applications that are used as alternatives in decision support systems. Because AHP is not too concerned with the number of respondents, the respondents in this study were determined to be several people who could represent the users of the quiz application. The respondents chosen were people who used to use the quiz applications Kahoot, Quizizz, Mentimeter, Quizlet, and Educandy.

C. Conducting Questionnaire Design and Distribution

After determining the criteria, alternatives, and respondents who are used as sources of assessment data, the next step is to design or design several questions related to weighting or pairwise comparisons against criteria, sub-criteria, and alternatives. The design of the questionnaire and its questions must be easily understood by the respondents so that the scores obtained can be accurate and as expected.

Table 2. Research Questionnaire Design Between Criteria

	Category																
Security	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Ease to use
Security	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Features and Feedback
Security	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Stable Connectivity
Security	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Results and feedback
Ease to use	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Features and Feedback
Ease to use	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Stable Connectivity
Ease to use	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Results and feedback
Features and Feedback	9	**8**	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Stable Connectivity
Features and Feedback	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Results and feedback
Stable Connectivity	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Results and feedback

Table 3. Criteria Research Questionnaire Design with Alternatives

App	Security																App
A. Kahoot	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	B. Quiziz
A. Kahoot	9	**8**	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C. Mentimeter
A. Kahoot	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	D. Quizlet
A. Kahoot	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	E. Educandy
B. Quiziz	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	C. Mentimeter
B. Quiziz	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	D. Quizlet
B. Quiziz	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	E. Educandy
C. Mentimeter	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	D. Quizlet
C. Mentimeter	9	**8**	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	E. Educandy
D. Quizlet	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	E. Educandy

D. Performing Processing Results Analysis

Respondent data that has been collected is then entered into the online AHP application one by one to determine the results of calculations based on criteria. These data will be the determining factor for decision analysis in determining the best quiz application. After data processing and testing, both manually and the results of implementation with Expert Choice, will be analyzed from the results obtained from the two methods. This research can be said to be successful if the final results of the priority assessment of the proposed alternatives in manual processing and testing have the same final priority order with the implementation results using Expert Choice.

Before determining the pairwise comparison matrix between criteria, the intensity of the importance of each criterion must first be determined. The function of determining the intensity of the importance of each criterion is to avoid comparison ratio (CR)> 0.1 or inconsistent. The comparison of the AHP paired criteria matrix can be seen in Table 2.

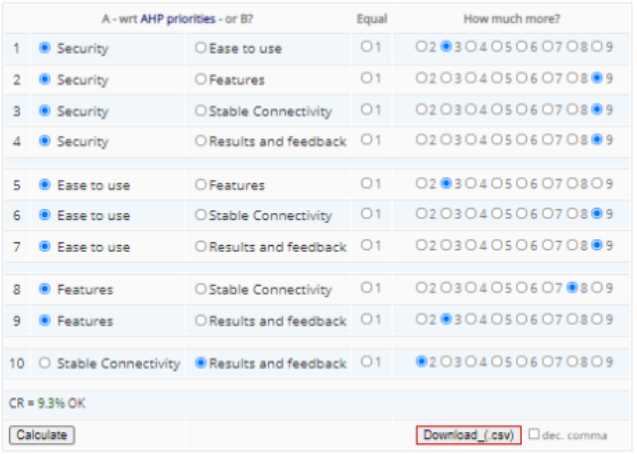

Figure 3. AHP Calculator Criteria Comparison

The weight value of each category is then developed in the form of a table to map the five alternatives combined with all aspects of the criteria. Furthermore, the weights and scores were determined for each relationship between the alternatives and the criteria with the help of users who usually use quiz applications in teaching and learning activities. The lowest score is 1 if the alternative does not meet the related criteria and the maximum score is 9 for the alternative that meets the criteria perfectly. The table of assessment results is as follows.

After all the questionnaire data is entered into the AHP calculator, it is necessary to normalize the data in order to avoid CR> 0.1 so that the normalized relative weights can be obtained.

Table 4. Comparison Matrix Between Criteria

Category		Priority	Rank
1	Security	55.3%	1
2	Easy to Use	26.2%	2
3	Features	11.4%	3
4	Stable Connectivity	2.9%	5
5	Results and feedback	4.2%	4

Table 5. Application Comparison Matrix Based on Stable Connectivity Criteria

Category		Priority	Rank
1	Kahoot	61.0%	1
2	Quizizz	11.7%	2
3	Mentimeter	10.7%	4
4	Quizlet	5.3%	5
5	Educandy	11.4%	3

Based on the connectivity stability criteria, Kahoot is ranked first with a score of 61.0%. Quizizz was ranked second with a score of 11.7%. Educandy ranks third with a value of 11.4%. In fourth place, Mentimeter got a score of 10.75. Quizlet was ranked last based on the connectivity stability criteria with a value of 5.3%.

Table 6. Application Comparison Matrix Based on Result and Feedback Connectivity Criteria

Category		Priority	Rank
1	Kahoot	45.3%	1
2	Quizizz	16.3%	2
3	Mentimeter	16.3%	2
4	Quizlet	5.9%	5
5	Educandy	16.3%	2

Based on the results and feedback criteria, Kahoot was ranked first with a score of 45.3%. Quizizz, Educandy, and Mentimeter got the same score in second place, namely 16.3%. Quizlet was ranked last based on the results and feedback criteria with a score of 5.9%.

Table 7. Application Comparison Matrix Based on Stable Connectivity Stable Connectivity - Respondent 1

Category		Priority	Rank
1	Kahoot	55.0%	1
2	Quizizz	20.3%	2
3	Mentimeter	9.8%	3
4	Quizlet	5.9%	5
5	Educandy	8.9%	4

Respondent 1 representing male respondents gave an assessment of 55.0% for Kahoot for the connectivity stability criteria. In second place, Quizizz received a rating of 20.3%. Mentimeter is in third place with a rating of 9.8%. Educandy ranks fourth with a rating of 8.9%. In the last place, Quizlet got a rating of 5.9%.

Table 8. Application Comparison Matrix Based on Stable Connectivity Stable Connectivity - Respondent 2

Category		Priority	Rank
1	Kahoot	61.0%	1
2	Quizizz	11.7%	2
3	Mentimeter	10.7%	4
4	Quizlet	5.3%	5
5	Educandy	11.4%	3

Respondent 2 representing female respondents gave an assessment of 61.0% for Kahoot for the connectivity stability criteria. In the second place, Quizizz received a rating of 11.7%. Educandy is in third place with a rating of 11.4%. Mentimeter ranks fourth with a rating of 10.7%. In the last place, Quizlet got a rating of 5.3%.

Furthermore, the results of each assessment are multiplied by the weight of each criterion. To find the total rating for each of the best alternative applications, the value of each application based on the criteria is multiplied by the criteria value. The row result of each value is multiplied by the column of criteria values.

Table 9. Respondent Final Matrix 1

Comparison Matrix	Security	Easy to Use	Features	Stable Connectivity	Results and feedback	Total	Rank
	55.3%	26.2%	11.4%	2.9%	4.2%		
Kahoot	28.9%	53.0%	54.9%	55.0%	41.4%	39.5%	1
	16.0%	13.9%	6.3%	1.6%	1.7%		
Quizizz	18.0%	23.0%	25.4%	20.4%	23.9%	20.5%	3
	10.0%	6.0%	2.9%	0.6%	1.0%		
Mentimeter	5.0%	13.1%	10.1%	9.8%	16.4%	8.3%	4
	2.8%	3.4%	1.2%	0.3%	0.7%		
Quizlet	3.6%	7.7%	5.7%	5.9%	7.7%	5.2%	5
	2.0%	2.0%	0.6%	0.2%	0.3%		
Educandy	44.5%	3.2%	3.9%	8.9%	10.6%	26.6%	2
	24.6%	0.8%	0.4%	0.3%	0.4%		
Total	100.0%	100.0%	100.0%	100.0%	100.0%		

All scores from each respondent are collected and calculated to get the best quiz app ranking.

Table 10. Final Matrix of all Respondents

APPS		Kahoot	Quizizz	Menimeter	Quizlet	Educandy
RESPONDENT (%)	R1	39.5%	20.5%	8.3%	5.2%	26.6%
	R2	21.8%	18.7%	19.2%	20.1%	20.1%
	R3	25.7%	22.2%	20.0%	17.2%	14.8%
	R4	23.4%	52.6%	14.1%	6.6%	3.4%
	R5	34.5%	18.9%	9.1%	6.7%	30.8%
	R6	21.2%	20.3%	20.0%	18.8%	19.7%
	R7	46.4%	25.8%	14.4%	6.3%	7.1%
	R8	13.6%	26.7%	18.1%	7.4%	34.2%
	R9	22.9%	12.9%	20.3%	29.4%	14.5%
AVARAGE (%)		27.7%	24.3%	15.9%	13.1%	19.0%
RANK		1	2	4	5	3

Based on the calculation of the overall average criteria contained in table 4, the best quiz application chosen by the respondents was Kahoot with an average score of 27.67%. Quizizz ranks 2nd with an average score of 24.29%. Educandy ranked 3rd with an average score of 19.02%. Menimeter ranked 4th with an average score of 15.94%. Quizlet ranked 5th with an average score of 13.08%.

V. Conclusion

AHP (analytic hierarchy process) is a selection method based on many criteria. Based on research in the best quiz applications, AHP ranks each of these applications. Kahoot got the highest ranking with a score of 27.7%, followed by Quizizz with a score of 24.3% and so on. Based on the available data, Kahoot is the best quiz application based on the criteria of security, ease of use, features, stability of connectivity, as well as results and feedback.

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