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Decision Support System For The Selection of Prodigious Students Using Ahp-Topsis Combination Method (Case Study: Abu Bakar Ash Shiddiq Integrated Islamic Elementary School)

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ABSTRACT

This study designs a decision support system that utilizes a combination of AHP and TOPSIS methods to select prodigious students on Abu Bakar Ash Shiddiq Integrated Islamic Elementary School. Manual selection processes can present several challenges, such as requiring significant time when numerous criteria are involved and a large number of students participate. Additionally, the selection process may be influenced by subjective judgments from the committee. To address these challenges, a decision support system is proposed, utilizing AHP and TOPSIS method. AHP method was used because it has the advantage of determining the weights and hierarchy of evaluation criteria, while the TOPSIS method can measure the relative performance of decision alternatives in a mathematical form to identify the best alternative.This decision support system can aid the selection committee in choosing high-achieving students more efficiently. Implementing a decision support system with combination of AHP and TOPSIS method in this study helps address issues by minimizing the time needed for the selection process and ensuring more objective selection results.

1. INTRODUCTION

Improving the quality of education is essential for the advancement of a school. One key aspect of educational quality is the academic process and student performance assessment, as these serve as benchmarks for the success of an educational institution (Westley, 2011). Student performance evaluation is conducted to assess and rank students who have completed learning activities in both curricular and extracurricular fields at school, as well as to recognize and reward high-achieving students. Therefore, student assessment is a crucial factor in the academic process of a school. To achieve this, schools must continuously evaluate and enhance their services to students, including teaching methods, assessment processes, and quality assurance. This ensures that the school becomes competitive, high-achieving, and maintains a strong reputation. Participating in student achievement competitions can also help develop students' skills and enhance the school's recognition.

One school program that can develop the potential of students is the existence of a selection program for prodigious students. Academic achievement becomes very important for a student.This program can increase student learning interest and as a reward for students who have a good academic record. This program also done by Abu Bakar Ash Shiddiq Integrated Islamic Elementary School Margorejo sub-district, Pati District. The selection of prodigious students is an initiative by the school to identify potential candidates who will be prepared to compete in student achievement competition. Several issues emerge when the selection process is conducted manually such as requiring significant time when numerous criteria are involved and a large number of students participate. Additionally, the selection process may be influenced by subjective judgments from the committee. To address these challenges, a decision support system is proposed.

A Decision Support System (DSS) is designed to assist in every stage of the decision-making process, including problem identification, selecting relevant data, determining the appropriate approach, and evaluating alternative options (Khodashahri, Mir and Sarabi, 2013). Decision support system applications are extensively utilized to address challenges in decision-making. The outcomes generated by a decision support system depend on the predefined criteria. With the goal in this case is to help the school committee determine prodigious students based on predefined criteria using decision support system which enabled decision-making to be faster and more precise with the help of advancements in existing information technology.

Based on the mentioned challenges, researchers are interested to design and develop a decision support system using combination of AHP and TOPSIS method that can solve these problems. The selection of these methods is based on the advantages they offer: the AHP method excels in determining weights and the hierarchy of assessment criteria, while the TOPSIS method is capable of measuring the relative performance of decision alternatives in a mathematical form (Bayhaqqi, Bukhori and Santika, 2021). The objective of this research is to develop a system that can assist in decision-making using combination of AHP and TOPSIS methods, enabling comitte to evaluate student performance effectively and efficiently while minimizing subjectivity in the assessment process.

2. RESEARCH METHODOLOGY

(Katarina *et al.*, 2020) Based on existing research, the author explains the use of the AHP method to select the best student recommendations by providing solutions to complex multi-factor or multi-criteria problems through the construction of a hierarchy, assigning subjective values to the relative importance of each variable, and determining which variable has the highest priority. The decision-making process is essentially about choosing the best alternative, such as structuring the problem, determining alternatives, determining possible values for random variables, setting values, time preference requirements, and risk specifications. The main tool of AHP is to have a functional hierarchy with the primary input being human perception. With a hierarchy, complex and unstructured problems are solved into their groups and organized in a hierarchical form. As a result can be done optimally because it can produce data results as expected,

(Rahmadhani, Van FC and Yunefri, 2022) This study explains the selection of outstanding students to participate in competitions, limited-quota scholarships, or other activities using a decision-making method to avoid subjectivity. AHP and SAW methods are the most used methods to determine the best alternative. Therefore, a comparative analysis of the methods was conducted to identify the most accurate approach for selecting outstanding students. The research compares the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods to identify the most accurate method for recognizing outstanding students.

(Putri, Sumijan and Enggari, 2024) In this study, The author utilizes a Decision Support System (DSS) to evaluate employee performance and facilitate the selection of top-performing employees by applying the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods.The AHP method helps in decision-making by comparing each criterion of the problem to derive a weighted value for each criterion. On the other hand, the TOPSIS method focuses on identifying the best alternative by calculating the shortest or farthest distance from the ideal solution.

(Suryani *et al.*, 2024) in their journal explained about in the school setting, identifying exceptional students holds considerable importance. High academic performance and low failure rates are indicators of the overall educational quality. Interviews reveal that the current method of evaluating outstanding students requires improvement, as the existing decision-making system does not account for various factors, leading to an inefficient selection process. This issue stems from conflicts of interest in assessments and inconsistencies in evaluation methods. To address this issue, a Decision Support System (DSS) is required to assist schools in recognizing high-achieving students. A DSS is an interactive platform that provides access to data and modeling tools, aiding decision-making in both structured and unstructured contexts. The final outcomes indicate that applying the The TOPSIS method in this decision support system improves the effectiveness and precision of identifying exceptional students in the school environment.

(Vivek Sharma, Bangri and Iskandar, 2024) Based on the study carried out, the author explained The TOPSIS method was chosen for its ability to handle a variety of criteria, allowing evaluations based on both academic and non-academic achievements, leadership skills, and positive attitudes. Data was gathered through observational and documentary methods, collecting information on student performance and other relevant factors. This data was then entered into the system to calculate relative scores for each student based on predefined criteria weights. As a result, the students were ranked according to their performance in relation to these criteria. The research results revealed that the Decision Support System (DSS) achieved an overall score of 90.3% in selecting outstanding students using the TOPSIS method, showcasing the system's successful implementation and its significant advantages in the student selection process.

2.1 Data Collection Methods

To ensure the data is accurate, relevant, valid, and reliable, the author gathers data from the following sources:

a. Primary Data Sources
   Primary data sources refer to data collected directly from organizations, either through direct observation or by recording research subjects, using the interview method (Ajayi, 2017). Interviews were carried out with key informants or stakeholders, specifically at Abu Bakar Ash Shiddiq Integrated Islamic Elementary School, Pati District, which serves as the subject of the research.
b. Secondary Data Sources
   Secondary data sources are not obtained directly, but these data can be collected through books, documentation, and various literature (Ajayi, 2017), including:
   1. Literature Study
      The literature review method is a data collection approach that involves searching for information in books, such as those on software engineering, relevant reports, and other resources. This method provides a theoretical foundation and serves as comparative material for the research, by examining references from previously completed thesis reports.
   2. Documentation Studies
      The documentation study method involves collecting data from literature and sources such as the internet, books, or other informational materials. In this study, data collection will involve requesting information from the research subjects, such as student assessment data from Abu Bakar Ash Shiddiq Integrated Islamic Elementary School, Pati District. This approach ensures that the information and data obtained are accurate and valid.

2.2 System Development Methods

The system development method plays a crucial role in system analysis. In this system design, the development method implemented follows the Waterfall model. According to Sukamto & Shalahuddin (2018) in their book Structured and Object-Oriented Software Engineering, the Waterfall model offers a structured and sequential approach to the software development lifecycle. This model progresses through distinct stages, including analysis, design, coding, testing, and maintenance, ensuring a systematic flow from one phase to the next (Hasanah, 2020).

2.3 System Analysis

Actors are anyone who describes the users of the system.. The actors in the Decision Support System For The Selection Of Prodigious Students Using Ahp-Topsis Combination Method (Case Study: Abu Bakar Ash Shiddiq Integrated Islamic Elementary School) are as follows:

1. Administrative Staff
   a. Manages user accounts.
   b. Records data of employees and students.
   c. Creates classes and schedules subjects based on subject data.
2. Principal
   a. Monitors data managed by the administrative staff.
   b. Oversees subject data prepared by the Curriculum Coordinator.
   c. Approves report cards created by homeroom teachers.
3. Curriculum Coordinator
   a. Prepares subject data to be submitted to the administrative staff.
   b. Approves schedules created by homeroom teachers.
4. Subject Teachers
   a. Prepare and compile student grades.
   b. Submit the grades to the homeroom teacher for further processing.
5. Homeroom Teachers
   a. Collect and compile grades from subject teachers.
   b. Create report card data based on the compiled grades.
6. Students/Parents
   a. Can check class schedules.
   b. View report card grades prepared by subject teachers and homeroom teachers.

Table 1. Business processes used in the system

No.	Business Process	Actor	Business Use Case
1	The administrative staff (TU) manages data of teachers, students, parents, classes, homeroom teachers, curriculum coordinators, and the principal.	Administrative Staff	Manage data of teachers, students, parents, classes, homeroom teachers, curriculum coordinators, and the principal.
2	The curriculum coordinator manages subject data.	Curriculum Coordinator	Manage subject data.
3	The curriculum coordinator assigns subject teachers based on the subject data created.	Curriculum Coordinator	Assign subject teachers.
4	The curriculum coordinator manages assessment criteria and evaluation weights used to determine student rankings.	Curriculum Coordinator	Manage assessment criteria and evaluation weights.
5	The administrative staff arranges the subject schedule based on the subjects prepared by the curriculum coordinator.	Administrative Staff	Arrange subject schedule.
6	The administrative staff submits the prepared subject schedule to the curriculum coordinator.	Administrative Staff	Submit subject schedule.
7	The administrative staff stores the subject schedule approved by the curriculum coordinator.	Administrative Staff	Store subject schedule.
8	Teachers, students, and parents receive the subject schedule.	Teachers, Students, or Parents	Receive subject schedule.
9	Subject teachers input attendance, extracurricular scores, assignment scores, midterm exam, and final exam scores.	Subject Teachers	Input assignment, midterm exam, and final exam scores.
10	Homeroom teachers or class coordinators manage the	Homeroom Teachers or Class Coordinators	Manage scores.

	scores provided by subject teachers.		
11	Homeroom teachers prepare report card data and submit it to the principal for approval.	Homeroom Teachers	Prepare report card.
12	The principal approves the report card and returns it to the homeroom teacher.	Principal	Approve report card.
13	The administrative staff stores the report card approved by the principal.	Administrative Staff	Store report card.
14	Parents or students receive notifications and obtain the report card from the homeroom teacher.	Parents or Students	Receive report card.

2.4 Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) according to Prof. Thomas L. Saaty "Decision making with the analytic hierarchy process" is a method for measuring the importance of qualitative factors with high complexity using the AHP method. The AHP method has 4 important principles that must be understood, namely: decomposition, pairwise comparison, priority synthesis, and logical consistency.

a. Decomposition

In the AHP method, decomposition is the process of simplifying a complex problem into a hierarchical form. The simplification of a multicriteria problem into a hierarchical structure consists of 3 components: goals, criteria, and alternative choices. Below is a depiction of the hierarchy in the decomposition principle of the AHP method as in figure 1:

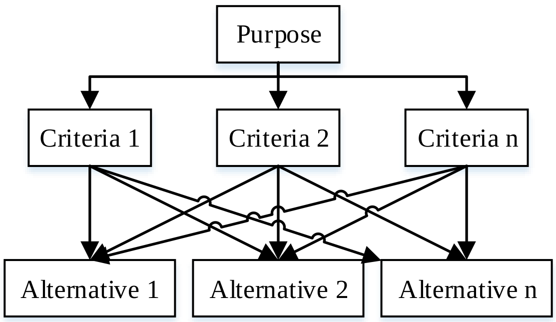

Figure 1. Hierarchy in the AHP Method

b. Pairwise Comparison

The main focus of the AHP method is to use Saaty's comparison scale table in conducting pairwise comparisons. AHP is used to assist in decision-making by combining subjectivity and data, which will later be weighted according to the predetermined priorities. According to Prof. Thomas L. Saaty to perform pairwise comparisons we can use this table 2 as guidelines :

Table 2. Fundamental Scale for Pairwise Comparisons

Level of Importance	Definition	Explanation
1	Both elements are equally important.	Two elements with the same level of influence in decision-making.
3	One element is slightly more important than the other (Weak importance of one over another).	Experience and judgment indicate that one element plays a slightly more significant role than the other.
5	One element is more important than the other (Essential or strong importance).	Experience and judgment indicate that one element plays a significantly more important role than the other.
7	One element is clearly and absolutely more important than the other (Demonstrated importance).	One element plays a very significant role and is visibly dominant in practice.
9	One element is absolutely more important than the other (Extreme importance).	Evidence supports that one element is at the highest rank.
2, 4, 6, 8	Values between two adjacent judgment values. This value is given when there is a compromise between two choices.	
Reciprocal	If activity i receives a certain value compared to activity j, then j has the reciprocal value compared to i.	

Source : (Bayhaqqi, Bukhori and Santika, 2021)

c. Synthesis of Priority

Each predetermined criterion will contribute to achieving the goal of problem-solving. In the AHP method, the magnitude of each criterion's contribution is determined.

d. Logical Consistency
In AHP, logical consistency is essential. In the decision-making process, it is crucial to determine how well the existing consistency is maintained. The Random Consistency Index can be seen in table 3 below:

Table 3. List of Random Consistency Index

Matrix Size (n)	IR Value (Random Index)
1, 2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49
11	1,51
12	1,48
13	1,56
14	1,57
15	1,59

Source : (Bayhaqqi, Bukhori and Santika, 2021)

In general, the steps in using the AHP method for solving a problem are as follows:

1. Create a pairwise comparison matrix by considering the fundamental scale for pairwise comparisons according to Equation 1.

$$A = [a_{im}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & & 1 \end{bmatrix} \qquad (1)$$

i, m = 1, 2, …, n = index of the determined criteria.

2. Normalizing the decision matrix is done by summing each column of the matrix, then dividing each criterion in the decision matrix by the total value of its column. After that, the row averages of the matrix are determined, forming a set of n weights W, namely W1, W2, …, Wn according to Equation 2.

$$W : W = \{W_{1,} W_{2,}, W_{n,}\} \qquad (2)$$

Normalize the pairwise comparison matrix table using Equation 3.

$$\sum i \, a_{ij} = 1 \qquad (3)$$

Finding the weight vector is done by calculating the average for each row using Equation 4.

$$W_i = \frac{1}{n} \sum i \, a_{ij} \qquad (4)$$

3. Determine the consistency level of the pairwise comparison matrix obtained from the previous step. The steps in this stage are as follows:
   a. Multiply each value in the first column by the relative priority of the first criterion, the value in the second column by the relative priority of the second criterion, and so on.
   b. Sum the values in each row. Then, divide the sum by the corresponding relative priority criterion value.
   c. Sum the results from step (b) with the number of criteria, which is then referred to as λ max.
   d. Calculate the Consistency Index (CI) using Equation 5.

   $$CI = (\lambda_{maks} - n)/n - 1 \qquad (5)$$

   Where n is the number of criteria.
   e. Calculate the Consistency Ratio (CR) using Equation 6.

   $$CR = CI/I \qquad (6)$$

   Explanation**:** IR = Random Consistency Index or Ratio Index (the ratio index value depends on the matrix size), and CR = Consistency Ratio.

4. Consistency ratio or pairwise comparison matrix in the AHP method can be used if the resulting value is less than 10%. If this condition is not met, the comparison must be repeated until it meets the requirement set by the decision-maker.

2.5 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is a multi-criteria decision-making approach initially proposed by Yoon and Hwang in 1981. TOPSIS is one of the methods used for multi-criteria decision-making. The fundamental concept of the TOPSIS method is that the best alternative is the one with the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Amiri-Aref, Javadian and Kazemi, 2012).

The steps in the TOPSIS method are:

1. Create a normalized decision matrix**.** The TOPSIS method requires the performance rating of each alternative for each criterion to be normalized. The equation for the normalized matrix can be seen in Equation 7.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}}} \qquad (7)$$

i = 1, 2, …, m; and j = 1, 2, …, n.
r_{ij} = normalized decision matrix. x_{ij} = weight of the j criterion for the i alternative.
i = i alternative of interest.
j = j criterion of interest.

2. The weighted normalized decision matrix is created according to equation 8.

$$V = \begin{bmatrix} W_{11} r_{11} & \cdots W_{1n} r_{1n} \\ \vdots & \ddots \\ W_{m1} r_{m1} & \cdots W_{nm} r_{nm} \end{bmatrix} \qquad (8)$$

3. The value of the weighted normalized matrix, denoted as yij, can be calculated using equation 9.

$$y_{ij} = w_j r_{ij} \quad (9)$$

With I = 1, 2, … m; and j = 1, 2, … n; where Wj is the weight of the j criterion. The weight assignment uses the results from the previous AHP calculation.

4. Determining the positive ideal solution matrix and the negative ideal solution matrix, based on the normalized weight ratings, allows for the determination of the positive ideal solution (A+) and the negative ideal solution (A-). Before determining the ideal solutions, it is necessary to establish whether the attribute is of a benefit (profit) or cost nature.

$$A^+ = (y_i^+, y_2^+, \dots, y_{2n}^+) \quad (10)$$
$$A^- = (y_i^-, y_2^-, \dots, y_{2n}^-) \quad (11)$$

Description: y_i^+=max$_i$ y_{ij} is the benefit attribute, and y_i^-=max$_i$ y_{ij} is the cost attribute.

5. The definition of a benefit attribute is an attribute that is assigned to the highest value to achieve the closest distance to the positive ideal solution, and the farthest distance is achieved using the negative ideal solution. On the other hand, the definition of a cost attribute is an attribute that is assigned to the smallest value to achieve the farthest distance from the positive ideal solution and the closest distance to the negative ideal solution.
y_j^+ is the largest value from the matrix y for each j-th criterion. y_j^- is the smallest value from the matrix y for each j criterion.
6. Determining the distance between the value of each alternative and the positive and negative ideal solution matrices. The distance between the value of alternative i and the positive ideal solution can be formulated using the following equation 12:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_j^+ - y_{ij})^2} \quad (12)$$

The distance between the value of alternative i and the negative ideal solution can be formulated using the following equation 13:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_i^-)^2} \quad (13)$$

D_i^+ is the distance between the value of alternative i and the positive ideal solution, and D_i^- is the distance between the value of alternative i and the negative ideal solution.
7. This stage involves determining the preference value for each alternative. The largest preference value (Vi) indicates alternative i and represents the most suitable option to be chosen as the best solution. The value of Vi can be calculated using equation 14.

$$V_i = \frac{D_i^-}{D_j^- + D_j^+} \quad (14)$$

8. Vi is the preference value that represents the value of alternative i. Once the values are obtained, the alternatives will be ranked based on the value order. The largest value indicates that alternative i is the most recommended solution.

3. RESULTS AND DISCUSSION

3.1 System Design

Following the completion of the analysis process, the system design phase proceeds using Unified Modeling Language (UML) diagrams. UML is a modeling language designed for developing software based on object-oriented programming techniques. The system design includes aspects such as interface design, aesthetics, content, navigation, architecture, and components. This study adopts an object-oriented design approach using UML (Bruegge and Riedel, 1994).

Several diagrams are generated during the analysis process. Among these diagram, the use case diagram illustrates in figure 2 the interaction between one or more actors and the information system being developed.

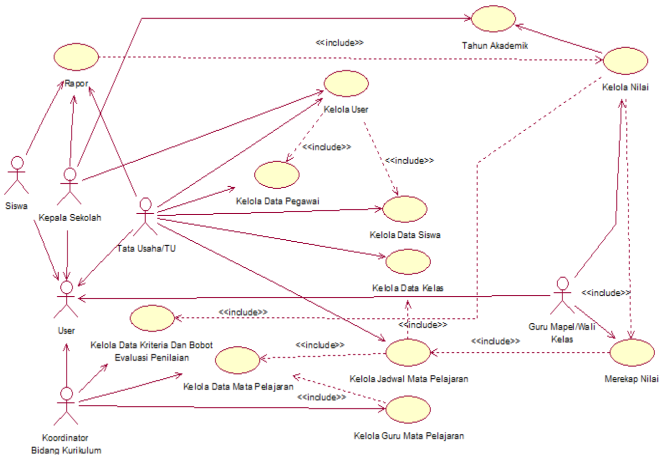

Figure 2. Usecase Decision Support System For The Selection Of Prodigious Students Using Ahp-Topsis Combination Method (Case Study: Abu Bakar Ash Shiddiq Integrated Islamic Elementary School)

A Class Diagram is used to represent multiple classes within the system or software being developed. It provides a comprehensive overview of the system/software and illustrates the relationships between the various classes. The following is the Class Diagram created for this case as in figure 3.

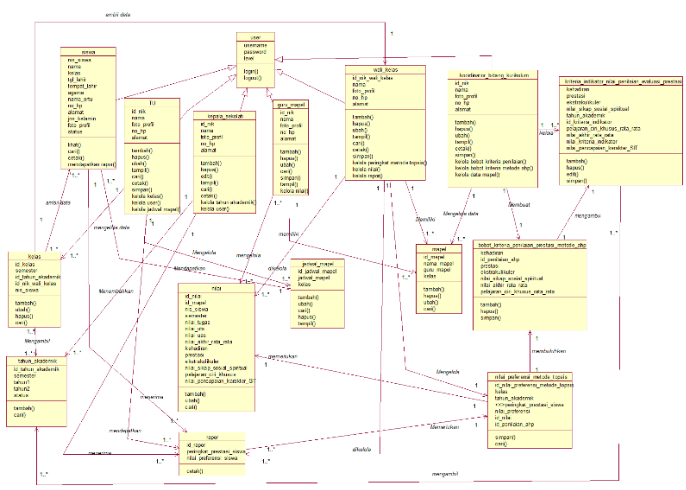

Figure 3. Class Diagram For The Selection Of Prodigious Students Using Ahp-Topsis Combination Method (Case

Study: Abu Bakar Ash Shiddiq Integrated Islamic Elementary School)

3.2 Analytic Hierarchy Process (AHP) Calculation Stages

1. Determine The Level Of Importance Between Criteria

In this study, the author employs ten distinct datasets, each providing comprehensive information about individual students. The alternative function utilized serves to evaluate evaluate and compare the performance or scores of the selected alternatives in the decision-making process. Alternatives are essential in linking input attributes or variables to output values, which are then utilized for ranking or choosing the most appropriate option. To enhance the analysis and computations, the author incorporates data from ten students as case examples. The ten student datasets listed below are utilized as alternatives in this research as in table 4.

Table 4. Alternative Data

Alternative Number	Student Name
A1	Abiyan Zaki Yudanto
A2	Aida Mufida Salma
A3	Aisyah Izza Azzahra
A4	Aisyah Zhafira Syahidah
A5	Annisa Wahyu Nur Azizah
A6	Asyraf Muazam Zulfan
A7	Chesta Legawa Arkananta
A8	Cintania Bunga Zakina
A9	Diandra Kirania Rayya
A10	Farah Muna Maulida

Table 3 above displays ten student data samples used as alternatives in this study. The data for alternatives was collected through an analysis of student grade documents. These grade documents were also provided by the principal and classroom teachers as part of the research object.

Once the available options have been identified, the next step is to determine the relevant criteria. In this study, the author identified these criteria through interviews with principal and homeroom teachers of Abu Bakar Ash Shiddiq Integrated Islamic Elementary School Pati, who were the research subjects. This study focuses on seven main criteria for analysis and consideration. The following seven evaluation criteria are used to assess high-achieving students in school as in table 5.

Table 5. Criteria Data

Code	Criteria	Type
C1	National Report Card Grades	Benefit
C2	Local Report Card Grades	Benefit
C3	Character Achievement Grades	Benefit
C4	Attendance Grade	Benefit
C5	Competency Points (Spiritual and Social)	Benefit
C6	Extracurricular Grades	Benefit
C7	Competition Achievements	Benefit

Table 4 above displays seven evaluation criteria: National Report Card Grades, Local Report Card Grades, Character Achievement Grades, Attendance Grade, Competency Points (Spiritual and Social), Extracurricular Grades and Competition Achievements. During interview priority of each criterion obtained.

1. National report card grades is as important as local report card grades.
2. Character achievement grades is as important as attendance grade, competency points (spiritual and social), and extracurricular grades.
3. National report card grades and local report card grades is quite important compared to character achievement grades, attendance grade, competency points (spiritual and social), and extracurricular grades.
4. National report card grades and local report card grades is more important competition achievements.
5. Character achievement grades, attendance grade, competency points (spiritual and social), and extracurricular grades is quite important compared to competition achievements.

After understanding the criteria weights, the next step is make pairwise comparison matrix

2. Create a pairwise comparison matrix

A pairwise comparison matrix is constructed using the predefined importance level values for each criterion.The decision matrix for comparing the criteria is presented in table 6.

Table 6. Pairwise Criteria Comparison Matrix

	C1	C2	C3	C4	C5	C6	C7
C1	1,00	1,00	3,00	3,00	3,00	3,00	5,00
C2	1,00	1,00	3,00	3,00	3,00	3,00	5,00
C3	0,33	0,33	1,00	1,00	1,00	1,00	3,00
C4	0,33	0,33	1,00	1,00	1,00	1,00	3,00
C5	0,33	0,33	1,00	1,00	1,00	1,00	3,00
C6	0,33	0,33	1,00	1,00	1,00	1,00	3,00
C7	0,20	0,20	0,33	0,33	0,33	0,33	1,00
Total	3,53	3,53	10,33	10,33	10,33	10,33	23,00

3. Perform normalization on each pairwise matrix value

Normalization is conducted by dividing each value in a column by the sum of all values in that column. The normalization of the pairwise comparison matrix values in Table 3 was carried out to scale them within the range of 0 to 1. The results of the normalized pairwise comparisons are presented in Table 7, as follows:

Table 7. Normalization Results of Pairwise Comparisons

	C1	C2	C3	C4	C5	C6	C7
C1	0,283	0,283	0,29	0,29	0,29	0,29	0,217
C2	0,283	0,283	0,29	0,29	0,29	0,29	0,217
C3	0,094	0,094	0,096	0,096	0,096	0,096	0,13

C4	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C5	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C6	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C7	0,056	0,056	0,032	0,032	0,032	0,032	0,043
Total	1	1	1	1	1	1	1

4. Calculate the average value of the criteria matrix

The average value is calculated by adding all the values in each row and dividing the sum by the total number of criteria.The results are presented in table 8 below.

Table 8. Weight Results for Each Criteria

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
C1	0,28	0,28	0,29	0,29	0,29	0,29	0,21
C2	0,28	0,28	0,29	0,29	0,29	0,29	0,21
C3	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C4	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C5	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C6	0,094	0,094	0,096	0,096	0,096	0,096	0,13
C7	0,056	0,056	0,032	0,032	0,032	0,032	0,043

The average values shown in Table 3 act as weights for calculations in the TOPSIS method to produce weighted normalization. The weight values obtained through the AHP method cannot be used directly; they must first pass a consistency test. The set of weights obtained from the AHP method is W with list = [0.277, 0.277, 0.1, 0.1, 0.1, 0.1, 0.04].

5. Determine the maximum Lamda (λ) value

To calculate the maximum lambda (λ) value, matrix multiplication is performed between the pairwise comparison matrix in Table 5 and the transposed weight values. The results of the maximum lambda (λ) values are presented in table 9.

Table 9. Maximum Lambda (λ) value

	C1	C2	C3	C4	C5	C6	C7	W	Max (λ)
C1	0,283	0,283	0,29	0,29	0,29	0,29	0,217	0,27	1,01
C2	0,283	0,283	0,29	0,29	0,29	0,29	0,217	2,27	1,01
C3	0,094	0,094	0,096	0,096	0,096	0,096	0,13	0,10	0,95
C4	0,094	0,094	0,096	0,096	0,096	0,096	0,13	0,10	0,95
C5	0,094	0,094	0,096	0,096	0,096	0,096	0,013	0,10	0,95
C6	0,094	0,094	0,096	0,096	0,096	0,096	0,13	0,10	0,95
C7	0,056	0,056	0,032	0,032	0,032	0,032	0,043	0,04	1,13
Total	1	1	1	1	1	1	1	1	6,99

6. Determine Consistency Index (CI)

This is the process for calculating the Consistency Index (CI).

$$CI = \frac{(\lambda_{maks} - n)}{n-1} = \frac{(6{,}99-7)}{7-1} = \text{-0,00063}$$

7. Determine Consistency Ratio

The consistency ratio (CR) is obtained by dividing the consistency index (CI) by the Random Index (RI). In this study, 7 criteria were used, yielding an RI value of 1.32. The CI calculation process is as follows.

$$CR = \frac{C(-0{,}00063)}{1{,}32} = \text{-0,000479798}$$

Since the resulting consistency ratio (CR) value (-0,000479798) is less than 0.1, the weight of each criterion is considered consistent. Therefore, the weights obtained through the AHP method can be used.

3.3 The Ranking Stage Using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

1. Constructing a decision matrix based on alternative data and criteria

The initial step is to construct a decision matrix based on alternative data and the criteria for selecting prodigious students at abu bakar ash shiddiq integrated islamic elementary school can see at table 10.

Table 10. Decision Matrix

Al	C1	C2	C3	C4	C5	C6	C7
A1	1932,83	264,625	42	10	16	8	10
A2	1958,6	273,75	43	10	14	10	10
A3	1921,5	259,875	38	10	12	10	0
A4	1862,77	222	40	10	12	8	0
A5	1944,93	264,375	37	10	18	8	0
A6	1914,47	245,125	40	10	14	10	0
A7	1926,6	240	37	10	16	8	0
A8	1917,07	265	44	10	12	8	0
A9	1942,53	266,125	39	10	15	10	0
A10	1926,17	251,375	41	10	11	8	0

2. Creation of a normalized decision matrix

The next step of TOPSIS method is to normalize the decision matrix using the formula in Equation 1. This step is crucial for managing scale differences among criteria. Normalization is performed by transforming each cell value in the decision matrix to ensure they fall within a standardized range, usually between 0 and 1. The results of this normalization are presented in Table 11.

Table 11. Decision Normalization Matrix

Al	C1	C2	C3	C4	C5	C6	C7
A1	0,32	0,33	0,33	0,32	0,36	0,29	0,71

A2	0,32	0,34	0,34	0,32	0,31	0,36	0,71
A3	0,32	0,32	0,30	0,32	0,27	0,36	0,00
A4	0,31	0,27	0,31	0,32	0,27	0,29	0,00
A5	0,32	0,33	0,29	0,32	0,40	0,29	0,00
A6	0,31	0,30	0,31	0,32	0,31	0,36	0,00
A7	0,32	0,30	0,29	0,32	0,36	0,29	0,00
A8	0,31	0,33	0,35	0,32	0,27	0,29	0,00
A9	0,32	0,33	0,31	0,32	0,33	0,36	0,00
A10	0,32	0,31	0,32	0,32	0,25	0,29	0,00

3. Generate a weighted normalized matrix by applying the priority weights derived from the AHP method.

The weighted normalized matrix is calculated by multiplying each alternative's value in the normalized decision matrix by its corresponding weight derived from the AHP method. The results of the normalized decision matrix are presented in Table 12.

Table 32. Results of the Weighted Normalized Decision Matrix

Ai	C1	C2	C3	C4	C5	C6	C7
A1	0,08	0,09	0,03	0,03	0,03	0,02	0,02
A2	0,08	0,09	0,03	0,03	0,03	0,03	0,02
A3	0,08	0,08	0,03	0,03	0,02	0,03	0,00
A4	0,08	0,07	0,03	0,03	0,02	0,02	0,00
A5	0,08	0,09	0,02	0,03	0,04	0,02	0,00
A6	0,08	0,08	0,03	0,03	0,03	0,03	0,00
A7	0,08	0,08	0,02	0,03	0,03	0,02	0,00
A8	0,08	0,09	0,03	0,03	0,02	0,02	0,00
A9	0,08	0,09	0,03	0,03	0,03	0,03	0,00
A10	0,08	0,08	0,03	0,03	0,02	0,02	0,00

4. Identify the matrices for the positive and negative ideal solutions.

The next step in the TOPSIS method involves determining the positive ideal solution (A^{+}) and the negative ideal solution (A^{-}) using the normalized weighted ratings (yij). The table below shows the outcomes of the positive and negative ideal solutions obtained from the weighted normalized matrix.

Table 43. Positive ideal solution

C1	C2	C3	C4	C5	C6	C7
0,089	0,094	0,034	0,031	0,04	0,036	0,028

Table 13 above displays the positive ideal solution for the seven criteria (C1-C7) within the TOPSIS method. These values represent the best possible performance for each criterion, derived from the weighted normalized matrix.

Table 14.. Negative ideal solution

C1	C2	C3	C4	C5	C6	C7
0,085	0,076	0,029	0,031	0,024	0,0288	0,00

Table 14 above shows the negative ideal solution for the seven criteria (C1-C7) in the TOPSIS method. These values are obtained by choosing the lowest values from the weighted normalized matrix.

5. Determine the distance between positive and negative ideal solutions

Once the matrix is normalized and the positive and negative ideal solutions are determined, The following step is to compute the distance of each alternative (Ai) from both the positive ideal solution (Di^{+}) and the negative ideal solution (Di^{-}) using Equations 11 and 12. This step assesses how close each alternative is to the maximum value (positive ideal solution) and how far it deviates from the minimum value (negative ideal solution) at the criterion level. The following is Table 12, which presents the distances of the existing alternatives from the positive ideal solution.

Table 155. Distance to the positive ideal solution

Al	Di+
A1	0,00927
A2	0,00904
A3	0,03262
A4	0,03759
A5	0,03044
A6	0,03202
A7	0,03276
A8	0,03287
A9	0,03003
A10	0,03465

Table 15 above displays the results of calculating the distance between each alternative (Di^{+}) and the positive ideal solution in the TOPSIS method. This distance is calculated using the Euclidean Distance formula, which shows how close each alternative is to the ideal maximum value for each criterion. Smaller distance values indicate that an alternative is closer to the positive ideal solution. Once the distance to the positive ideal solution is calculated, the next step is to compute the distance to the negative ideal solutionable. Table 16 below shows the results of the distance calculations to the negative ideal solution.

Table 66. Distance to the negative ideal solution

Al	Di-
A1	0,03465
A2	0,03590
A3	0,01530
A4	0,00328
A5	0,02179
A6	0,01311
A7	0,01317
A8	0,01614
A9	0,01946
A10	0,01097

Table 16 displays the results of calculating the distance between each alternative and the negative ideal solution in the TOPSIS method. This distance is calculated using the

Euclidean Distance formula, showing how far each alternative is from the least favorable minimum value for each criterion. Smaller distance values imply that an alternative is further away from the negative ideal solution.

6. Determine the preference value

The next step, after calculating the distance between each alternative and the positive and negative ideal solutions in the TOPSIS method, is to calculate the preference value (Vi) for each alternative using Equation 14. Table 17 below presents the results of the preference values (Vi).

Table 77. Preference value results

Alternative	Preference Value (V)
A1	0,7889
A2	0,7988
A3	0,3193
A4	0,0802
A5	0,4171
A6	0,2905
A7	0,2868
A8	0,3293
A9	0,3932
A10	0,2405

Table 16 above displays the preference values for each alternative in the TOPSIS method. These values reflect how effectively each alternative satisfies the defined criteria, with higher values indicating a closer distance to the positive ideal solution.

7. Ranking based preference value

The final results from the TOPSIS method are ranked based on the highest value for each student or alternative. The ranking results are shown in Table 18.

Table 188. Ranking Results

Alternative	The Final Result	Ranking	Decision
A2	0,798789879	1	Best 1
A1	0,788927904	2	Best 2
A5	0,41713227	3	Best 3
A9	0,393213226	4	Best 4
A8	0,329328515	5	Best 5
A3	0,319340473	6	Best 6
A6	0,290546904	7	Best 7
A7	0,286825795	8	Best 8
A10	0,240491557	9	Best 9
A4	0,080212168	10	Best 10

3.4 System Design Results

After conducting an analysis using the AHP and TOPSIS method, a ranking for each alternative was generated through calculations performed in Microsoft Excel. The following display represents the software design result utilizing the AHP and TOPSIS method to identify prodigious students at school.

1) Criteria Page

The criteria page displays a table containing the criteria data that has been previously entered. This page serves to present and organize the criteria information within the system. On this page, users have the ability to add, edit, print, and delete the available criteria information as needed can be seen at figure 4.

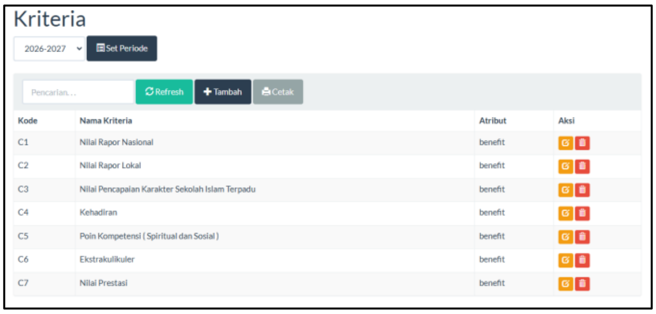

Figure 4. Criteria Page

2) Criteria Weight Page

On this page, users can modify the importance value of each criterion, reflecting its relative significance and intensity in comparison to the other criteria can be seen at figure 5.

Figure 5. Criteria Weight Page

3) AHP Weight Method Page

This page includes the normalization matrix, weights from the AHP method, Consistency Index (CI), and Consistency Ratio. Users can verify if the criteria weights from AHP are acceptable for use in the TOPSIS method can be seen at figure 6.

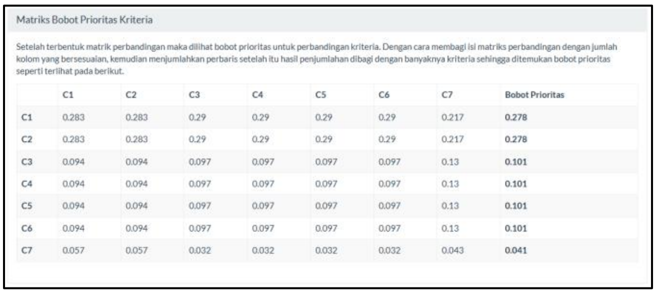

Figure 6. AHP Weight Method Page

4) Alternative Data Page And Weight Of Alternative Values

This table shows the alternatives and their corresponding weight values based on the predefined evaluation criteria. Users can modify the values for each alternative according to the established criteria can be seen at figure 7.

Alternative Data Page And Weight Of Alternative Values

2026-2027 Set Periode

Pencarian Refresh

Kode	Nama Kandidat	C1	C2	C3	C4	C5	C6	C7	Aksi
A1	Abiyan Zaki Yudanto	1932.833333	264.625	42	10	16	8	10	Ubah
A10	Farah Muna Maulida	1926.166667	251.375	41	10	11	8	0	Ubah
A2	Aida Mufida Salma	1958.6	273.75	43	10	14	10	10	Ubah
A3	Aisyah Izza Azzahra	1921.5	259.875	38	10	12	10	0	Ubah
A4	Aisyah Zhafira Syahidah	1862.766667	222	40	10	12	8	0	Ubah
A5	Annisa Wahyu Nur Azizah	1944.933333	264.375	37	10	18	8	0	Ubah
A6	Asyraf Muazam Zulfan	1914.466667	245.125	40	10	14	10	0	Ubah
A7	Chesta Legawa Arkananta	1926.6	240	37	10	16	8	0	Ubah
A8	Cintania Bunga Zakina	1917.066667	265	44	10	12	8	0	Ubah
A9	Diandra Kirania Rayya	1942.533333	266.125	39	10	15	10	0	Ubah

Figure 7. Alternative Data Page And Weight Of Alternative Values

5) Normalized Matrix TOPSIS Page

This page presents the results of the normalization matrix, derived from the previously defined alternative weight values. This offers a standardized representation of the alternative weight values, assisting users in better comprehending the relative comparison between alternatives based on the predefined criteria can be seen at figure 8.

Normalisasi

	C1	C2	C3	C4	C5	C6	C7
A1	0.31753	0.32732	0.33067	0.31623	0.35724	0.28571	0.70711
A2	0.31644	0.31093	0.32279	0.31623	0.2456	0.28571	0
A3	0.32176	0.33861	0.33854	0.31623	0.31258	0.35714	0.70711
A4	0.31567	0.32145	0.29918	0.31623	0.26793	0.35714	0
A5	0.30602	0.2746	0.31492	0.31623	0.26793	0.28571	0
A6	0.31952	0.32701	0.2913	0.31623	0.40189	0.28571	0
A7	0.31451	0.3032	0.31492	0.31623	0.31258	0.35714	0
A8	0.31651	0.29686	0.2913	0.31623	0.35724	0.28571	0
A9	0.31494	0.32779	0.34641	0.31623	0.26793	0.28571	0
A10	0.31912	0.32918	0.30705	0.31623	0.33491	0.35714	0

Figure 8. Normalized Matrix TOPSIS Page

6) The Weighted Normalization Page

This page displays the results of the weighted normalized matrix calculations from the calculation menu. This stage represents a more advanced step in the analysis process, where the previously calculated normalization values from AHP method are weighted based on the predefined criteria weights can be seen at figure 9.

Normalisasi Terbobot

	C1	C2	C3	C4	C5	C6	C7
A1	0.08822	0.09094	0.03336	0.0319	0.03604	0.02882	0.02886
A10	0.08791	0.08638	0.03257	0.0319	0.02478	0.02882	0
A2	0.08939	0.09407	0.03415	0.0319	0.03154	0.03603	0.02886
A3	0.0877	0.0893	0.03018	0.0319	0.02703	0.03603	0
A4	0.08502	0.07629	0.03177	0.0319	0.02703	0.02882	0
A5	0.08877	0.09085	0.02939	0.0319	0.04055	0.02882	0
A6	0.08738	0.08423	0.03177	0.0319	0.03154	0.03603	0
A7	0.08793	0.08247	0.02939	0.0319	0.03604	0.02882	0
A8	0.0875	0.09106	0.03495	0.0319	0.02703	0.02882	0
A9	0.08866	0.09145	0.03098	0.0319	0.03379	0.03603	0

Figure 9. The Weighted Normalization Page

7) The Ideal Solution Matrix Page

This displays the calculation of positive and negative ideal solutions in the calculation menu. This matrix compares each alternative with the positive ideal solution (best) and the negative ideal solution (worst) according to the predefined criteria can be seen at figure 10.

Matriks Solusi Ideal

	C1	C2	C3	C4	C5	C6	C7
positif	0.08939	0.09407	0.03495	0.0319	0.04055	0.03603	0.02886
negatif	0.08502	0.07629	0.02939	0.0319	0.02478	0.02882	0

Figure 10. The Ideal Solution Matrix Page

8) Solution Distance & Preference Page

This page shows the results of solution distance calculations and preference values in the calculation menu. The solution distance indicates the proximity of each alternative to the positive or negative ideal solution. Meanwhile, the preference value represents the relative ranking of each alternative by comparing their solution distances can be seen at figure 11.

Jarak Solusi & Nilai Preferensi

	Positif	Negatif	Preferensi
A1	0.00927	0.03465	0.78889
A10	0.03465	0.01097	0.24049
A2	0.00905	0.0359	0.79875
A3	0.03262	0.0153	0.31935
A4	0.03759	0.00328	0.08023
A5	0.03044	0.02179	0.41717
A6	0.03202	0.01311	0.29058
A7	0.03275	0.01318	0.28687
A8	0.03287	0.01614	0.32933
A9	0.03003	0.01946	0.39324

Figure 11. Solution Distance & Preference Page

9) Alternative Ranking Results Page

This page displays the ranking results in the calculation menu. The ranking is determined by preference values derived from solution distances, offering a clear view of the priority order of alternatives based on the predefined criteria. Alternative Ranking Results Page can be seen at figure 12.

Perangkingan

	Total	Rank
A1 - Abiyan Zaki Yudanto	0.789	2
A10 - Farah Muna Maulida	0.24	9
A2 - Aida Mufida Salma	0.799	1
A3 - Aisyah Izza Azzahra	0.319	6
A4 - Aisyah Zhafira Syahidah	0.08	10
A5 - Annisa Wahyu Nur Azizah	0.417	3
A6 - Asyraf Muazam Zulfan	0.291	7
A7 - Chesta Legawa Arkananta	0.287	8
A8 - Cintania Bunga Zakina	0.329	5
A9 - Diandra Kirania Rayya	0.393	4

Cetak

Figure 12. Alternative Ranking Results Page

4. CONCLUSIONS

The selection process for prodigious student on Abu Bakar Ash Shiddiq Integrated Islamic Elementary School using a decision support system is more effective and efficient compared to the manual system. In the manual system, assessments do not have standardized criteria and rely solely on the decision-maker's perception, making it take a considerable amount of time to determine the selected prodigious student. By using a combination of the AHP and TOPSIS methods, it is expected to avoid bias and ensure a more objective selection of the Prodigious Student.

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