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Web-Based Decision Support System for Determining Outstanding Teachers Using the TOPSIS Method

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ABSTRACT

The most difficult thing in determining an outstanding teacher is the effort to eliminate the subjectivity factor so that every choice made is objective based on predetermined criteria. In order for the implementation of teacher selection to run, this makes the need for a decision support system that is able to provide assessment consistency with the application of normalization and provide convenience in the results of the scores that will be determined from each criterion. By applying the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, it is possible to determine the best alternative by looking at the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution. This system is also useful for schools in determining and calculating scores in determining teachers who are worthy of awards in the selection of outstanding teachers. This system has also been designed dynamically so that it can make it easier for school principals to determine criteria according to the school year. This is supported by the results of the system testing using beta conducted with 6 respondents, indicating that 83.3% of users agreed that the system was easy to use, while 66.6% considered the information provided satisfactory. This system effectively reduces subjectivity in decision-making and provides a faster and more efficient assessment process compared to the manual file-based selection method previously used at SMPN 9 Tasikmalaya.

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1. INTRODUCTION

Technological advancements have significantly improved organizational management in a number of areas, including education, in the current era of globalization and digitalization. Through the use of computerized decision support systems, information technology advancements allow organizations to make more objective and data-driven decisions. These systems have been successful in lowering subjectivity and enhancing the uniformity of evaluation procedures in a variety of fields.

Referring to law of the Republic of Indonesia No. 14 in Year 2005 concerning Teachers and Lecturers, in article 36 paragraph [1] mandates "Teachers who are outstanding, exceptionally dedicated, and/or serving in special areas are entitled to receive awards." Therefore, there needs to be a form of appreciation that aims to encourage motivation, dedication, loyalty, and professionalism of a teacher himself. Thus, it is expected to have a positive effect on improving

teaching performance. Decision Support System (DSS) is an interactive information system that provides information, modeling, and data manipulation [2]. This system is used to help with decision-making in semi-structured and unstructured situations, where no one knows exactly how decisions should be made [3].

There are a number of difficulties with SMPN 9 Tasikmalaya's current procedure for choosing exceptional teachers. The principal's direct evaluation and manual file review, which are subjective and inconsistent, are the main methods used for selection. Teachers may become dissatisfied and less motivated as a result of this subjective approach, which could result in bias in the selection process. Additionally, the evaluation methodology and criteria weighting in the manual process are opaque and time-consuming.

A computerized decision support system must be developed in order to handle these issues. This system's development calls for a methodical approach that incorporates transparent calculation techniques, consistent weighting mechanisms, and objective criteria. The system should be able to process several criteria at once while remaining impartial and producing results that can be independently verified. The TOPSIS method, which offers a mathematical basis for ranking options based on several criteria, is used in this study to create such a system.

The relevant research that has been carried out is as follows: Decision Support System for Determining Exemplary Teachers at SMP N 24 Semarang Using the Simple Additive Weighting Method, researcher Aji Dewantoro [4], Exemplary Teacher Selection Decision Support System at Pancur Batu Main Era High School Using the Topsis Method, researcher Siti Maryam Siregar [5], Decision Support System for the Selection of Outstanding Teachers to Give Awards with the Topsis Method, Martaulina researcher [6]. Although previous research has discussed Decision Support Systems for determining outstanding teachers using various methods, this study focuses on the development of a web-based Decision Support System that facilitates data processing, calculations, and presentation of assessment results in real time. The TOPSIS method is not only used as a ranking tool but is also integrated into a system that can be accessed by related parties, thereby increasing efficiency, transparency, and consistency in decision-making. Thus, this study contributes not only to the method aspect, but also to the more practical application of the system in educational settings.

With the construction of a computerized decision support system, subjectivity in decision-making can be reduced and replaced with the implementation of all criteria. So that the best teachers will be selected [7]. With the aim: (1) To determine the criteria, and weight of each criterion according to the needs needed by the school, (2) To design and build a system for determining outstanding teachers so that the information produced is more effective, and of high quality. This system will be built dynamically, so that the school can add or replace the criteria needed for each period, (3) To apply the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to support decision-making in order to provide the best alternative in the selection of outstanding teachers at SMPN 9 Tasikmalaya [8].

2. METHOD

The method used in this study is Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) which is one of the multicriteria decision-making methods [9]. TOPSIS uses the principle that the chosen alternative must have the closest distance from the positive ideal solution and the farthest from the negative ideal solution from a geometric point of view by using Euclidean distance (the distance between two points) to determine the relative proximity of an alternative to the optimal solution. A positive ideal solution is defined as the sum of all the best achievable values for each attribute, while the negative-ideal solution consists of all the worst achievable values for each attribute [8].

The stages of implementing the TOPSIS method are: (1) compiling a decision matrix based on the alternatives and criteria that have been determined, (2) normalizing the decision matrix to eliminate unit differences between criteria, (3) forming a weighted normalized decision matrix by multiplying the normalization value by the weight of each criterion, (4) determining the positive ideal solution and the negative ideal solution, (5) calculating the distance of each alternative to the positive ideal solution and the negative ideal solution using the Euclidean distance, and (6) calculating the preference value for each alternative as a basis for the ranking process. The alternative with the highest preference value is declared the best alternative [9]

The data source was obtained directly from the principal, and the Curriculum section of SMP Negeri 9 Tasikmalaya which usually handles in determining outstanding teachers. There are two data collection techniques/methods used in this study, namely Field Studies, Literature Studies In sampling in this study, sampling techniques are used. Sampling technique is a way to determine the number of samples according to the sample size that will be used as the actual data source, by paying attention to the characteristics and distribution of the population

in order to obtain a representative sample [10]. To determine the number of samples to be used in the study, there are various sampling techniques used [11].

The method for sampling in this study uses the Simple Random Sampling Method. Simple Random Sampling is a method used to select a sample from a population in such a way (random) that each member of the population has an equal chance of being sampled. All members of the population become members of the sample frame [12].

The data analysis methods used for data analysis include Use Cases, Sequence Diagrams, Activity Diagrams, Class Diagrams, Entity Relationship Diagrams (ERD), File Structures, and Data Design. [13]. Functional Modeling and Information Flow used is by using *Unified Modeling Language (UML)* is a language standard used in the industrial world to define requirements, create analysis & design, and describe architecture in object-oriented programming [14].

The design method and system approach used is the SDLC method using a system approach called the waterfall approach [15], which uses several stages in the development of the system.

Where at each stage of the system can be revised or improved by the previous system. This can be described as follows: (1). System Planning, (2) System Analysis, (3) System Design, (4) System Implementation, (5) Testing, (6) Maintenance.

3. RESULT AND DISCUSSION

The System Analysis Stage is an activity of decomposing a complete information system into its component parts with the intention of identifying and evaluating problems, opportunities, obstacles that occur and expected needs so that improvements can be proposed.

3.1. Procedure Analysis

At this stage, an overview of the system that is currently running and studying the existing system is explained. Procedural analysis is needed to describe the flow of related information, to identify and evaluate problems, obstacles that occur and expected needs so that improvements to be made to the system can be proposed and then application design can be made. The following is a description of the system that runs in determining the selection of outstanding teachers at SMP Negeri 9 Tasikmalaya (1) The Head of the School provides information on the selection of outstanding teachers, (2) The Curriculum Workshop prepares the data needed in the selection of outstanding teachers, in the form of filing data for the past 1 year or during the selection period, (3) The Curriculum Workshop submits file data for 1 period, in the form of teacher data, data on attendance, performance, and teaching achievement to the Principal, (4) The Principal checks the file data for 1 school year, as a reference in the selection assessment for determining outstanding teachers, (5) The Principal chooses the best teacher as an outstanding teacher at SMP Negeri 9 Tasikmalaya.

3.2. System Weakness Analysis

The weakness of the selection process of outstanding teachers at SMP Negeri 9 Tasikmalaya has so far only been through the selection of files and direct election by the principal, so it is feared that subjectivity will arise in the selection and may cause social jealousy which results in a reduction in the performance of teachers who are selected to represent SMP Negeri 9 Tasikmalaya in the selection of outstanding teachers at the Tasikmalaya City Level.

Table 1. Proposed system to be submitted

No	Type of Analysis	Disadvantages of Legacy Systems	Proposed System
1	<i>Performance</i>	The selection of outstanding teachers is prone to subjectivity because it is only based on file selection and the principal's decision.	Computerized systems reduce subjectivity through objective criteria.
2	<i>Information</i>	The current system of determining outstanding teachers causes the process of conveying information about outstanding teachers to take a long time.	By using a computerized system, it will make it easier and faster in the process of delivering information because the selection process is carried out automatically.
3	<i>Economy</i>	Recording using paper or other media, in the long run, costs a lot so it is not economical.	With a computerized system, it will save time and procurement of media for data storage. And in the long run the costs incurred tend to be less.

No	Type of Analysis	Disadvantages of Legacy Systems	Proposed System
4	<i>Control</i>	The control over data processing is not thorough, so there is often a similarity in data.	The data will be safer because it is stored in a storage database and will facilitate control so that the possibility of errors and data similarities can be reduced.
5	<i>Efficiency</i>	In the old system, it was less efficient because it took a long time in assessing outstanding teachers, and searching for data.	With a computerized system, it will be faster and more efficient because the assessment process is carried out automatically by calculating each criterion.
6	<i>Services</i>	The service is not satisfactory due to the lack of consistent information provision, so it will be slow from the data processing process.	Services and data retrieval can be carried out faster by using a computerized system.

3.3. System Needs Analysis

The purpose of the analysis stage is to truly understand the needs of the new system and develop a system that can accommodate those needs, or decide that the development of a new system is not needed. Determining system needs is the most crucial step in the SDLC stage. The needs of the system can be interpreted as follows: (1) A statement about what the system should do, (2) A statement about the characteristics that the system must have.

3.4. System planning

System design is a description of a system or arrangement of several separate elements into a complete and functional unit. The design of the system is made based on the results of the analysis to solve the problems that exist at the analysis stage. At this stage, it is generally aimed at providing a general overview to the users of the new system, and also the preparation of a detailed design by identifying the components of the information system. In the design stage of the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya, what will be developed consists of Use Cases, Sequence Diagrams, Activity Diagrams, Class Diagrams, Entity Relationship Diagrams (ERD), File Structures, and Data Design.

3.4.1. Use Case Diagram

The Use Case is a modeling for the behavior of the system to be created. Use case describes an interaction between one or more actors and the information system to be created. The following is a use case diagram in the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya

3.4.2 Definition of Actor

The following is a description of the definition of actors in the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya:

Table 2. Definition of Actor

No	Actor	Description
1	Administrator	It is a person who is in charge and has access rights to carry out alternative data management operations, criteria, rankings, and manage system users.
2	Curriculum	It is a person who is in charge and has access rights to carry out alternative data checking operations, criteria, and ranking outstanding teachers.
3	Principal	It is a person who is in charge and has access rights to carry out alternative data checking operations, criteria, and ranking reports of outstanding teachers.
4	User (Students and teachers of SMP Negeri 9 Tasikmalaya)	It is a person who has access rights only to view ranking data, and the data of outstanding teachers who are selected in 1 period without having access rights to enter the system.

3.4.3. Use Case Definition

The following is a description of the definition of use cases in the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya:

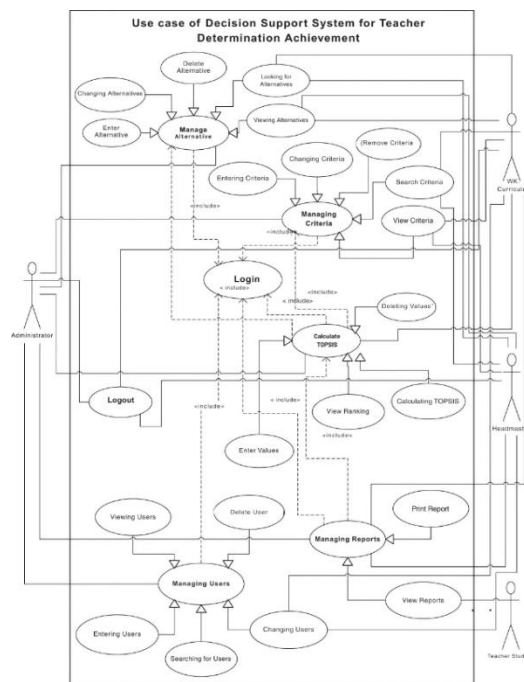


Figure 1. Use Case Diagram

Figure 1 presents the use case diagram of the decision support system, illustrating the interaction between four types of actors and system functionalities. The administrator has comprehensive access rights to manage all system components, including alternative data, criteria configuration, ranking calculations, and user management. The curriculum coordinator is responsible for data verification and checking processes, ensuring data accuracy before the ranking process. The principal has access to view ranking reports and final results for decision-making purposes. Meanwhile, general users (students and teachers) have limited access, allowing them to view published ranking results without the ability to modify system data. This access control structure ensures data security while maintaining transparency in the selection process.

3.4.4. Class Diagram

A class diagram describes the structure of a system in terms of defining the classes that will be created to build a system. A class diagram is created so that the program creator, or researcher creates classes as designed in the class diagram so that the design documentation and the software are in sync. The following is a class diagram of the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya:

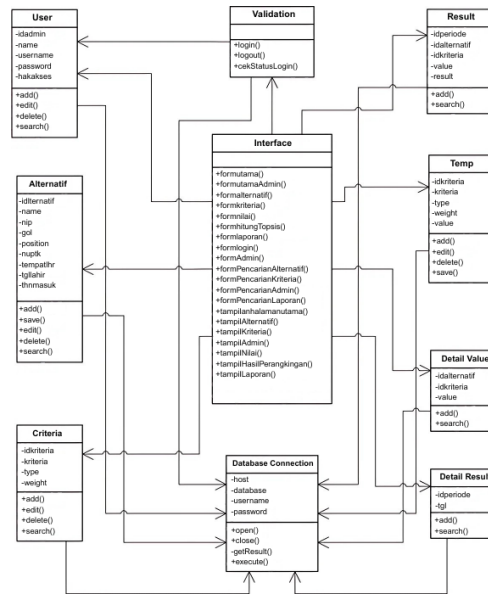


Figure 2. Class Diagram Decision Support System for Determining Outstanding Teachers

Figure 2 depicts the class diagram of the system, showing the relationships between different classes and their attributes. The diagram illustrates how data flows through the system, from user authentication, criteria management, alternative data input, to TOPSIS calculation and ranking output. Key classes include User, Criteria, Alternative, Weight, and Ranking, each with specific methods and attributes that support the overall system functionality. The relationships between classes are designed to maintain data integrity and support efficient calculation processes.

3.4.5. Entity Relationship Diagram (ERD)

Entity Relationship Diagram (ERD) is a model to explain the relationships between data in databases based on the basic objects of data that have relationships between relationships. The purpose of the Entity Relationship Diagram (ERD) is to model the structure of data and the relationships between data, to illustrate it using several notations and symbols.

The following is an ER diagram of the decision support system for determining outstanding teachers at SMP Negeri 9 Tasikmalaya:

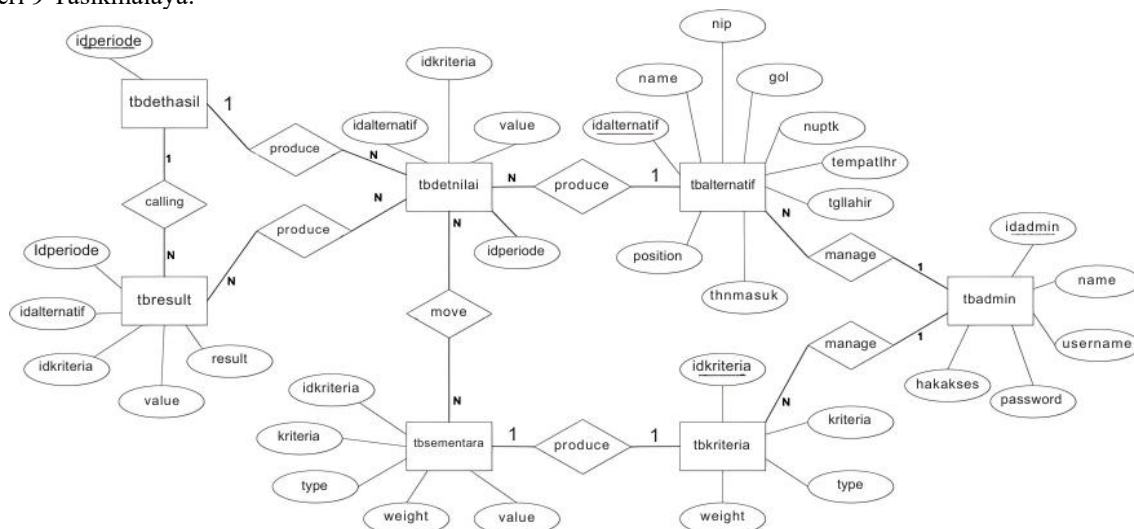


Figure 3. ERD Support System for Determining Outstanding Teachers at SMP Negeri 9 Tasikmalaya

Figure 3 presents the ERD that models the database structure for the system. The diagram shows the relationships between entities such as users, criteria, alternatives, assessments, and rankings. Primary keys and foreign keys are clearly defined to maintain referential integrity. This database design supports the dynamic nature of the system, allowing schools to add or modify criteria for different evaluation periods while maintaining historical data for reference and analysis.

3.4.6. *Betha Testing*

Beta testing is an objective test where it is tested directly in the field, namely the research site by making a questionnaire about user satisfaction, to be subsequently distributed to some users by taking a sample of 6 people. This questionnaire consists of 6 questions using a scale of 1 to 5. The scale provisions for each question are as follows:

Table 3. System Results Test Results

Answer Categories	Frequency of Answers	Total Sample Population	Total Percentages
Strongly agree	0	6	0 %
Agree	5	6	83,3 %
Enough	1	6	16,7 %
Disagree	0	6	0 %

Table 4. Information Test Results

Answer Categories	Frequency of Answers	Total Sample Population	Sum Percentage
Strongly agree	0	6	0 %
Agree	2	6	33,4 %
Enough	4	6	66,6 %
Disagree	0	6	0 %

Tables 3 and 4 present the results of beta testing conducted with 6 respondents. Table 3 shows system functionality test results, where 83.3% of respondents agreed that the system functions properly, with 16.7% rating it as adequate. No respondents disagreed or strongly disagreed, indicating positive acceptance of system functionality. Table 4 displays information quality test results, where 33.4% agreed and 66.6% rated the information quality as adequate. These results demonstrate that while the system is functional and usable, there is room for improvement in information presentation and user interface refinement. Overall, the positive feedback validates the system's readiness for deployment while identifying areas for future enhancement.

From the beta testing that has been carried out, namely by testing the calculation of the choice of answer categories from the questionnaire that has been distributed at the research site, based on the results of the statistical percentage above, it is concluded that the software built is easy to use and has a fairly good appearance.

4. CONCLUSION

Based on the results of the analysis, design, implementation, and testing that the author has carried out on the decision support system for determining outstanding teachers, the following conclusions are obtained: (1) After conducting an interview with the Principal, the criteria and weight of each criterion needed in determining outstanding teachers are obtained, including attendance, teaching achievement, performance, interviews, and student questionnaires, (2) With the construction of a decision support system for determining outstanding teachers, (2) With the construction of a decision support system for determining This outstanding teacher, the information obtained is more effective because the assessment criteria have been determined in determining outstanding teachers, and quality because the information from the results of determining outstanding teachers in this system can be used in determining outstanding teachers by the school. And this system has been built dynamically, so that SMP Negeri 9 Tasikmalaya can add and replace the criteria needed according to the school year. (3) Using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method can help the school in determining the best alternative to determining outstanding teachers, because it has the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

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