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Web-Based Decision Support System for Selecting Exemplary Teachers using TOPSIS Method

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***Abstract*—This study creates an online Decision Support System (DSS) using the TOPSIS algorithm to fairly choose outstanding teachers from vocational schools in Bekasi City, which has 87 state and private vocational secondary schools with about 62,000 students. To tackle the current biased selection process, our research uses a multi-criteria approach that looks at discipline (25%), travel costs (20%), personality (20%), teaching administration (15%), and learning achievements (20%). Targeting this substantial educational population, our research addresses the current subjective selection process by implementing a multi-criteria approach evaluating discipline (25%), travel costs (20%), personality (20%), teaching administration (15%), and learning achievements (20%). The TOPSIS method was selected for its proven effectiveness in ranking alternatives based on geometric distance from ideal solutions, particularly valuable in large-scale educational contexts. Analysis of 14 teacher candidates from SMK Bina Karya Mandiri demonstrated the system's precision, with Didi Saputra, S.Pdi, emerging as top-ranked (preference value: 0.63). When extrapolated to Bekasi's 87 SMKs, the model shows potential to standardize teacher assessment citywide, reducing regional disparities in recognition practices. The web-based platform enhances accessibility, allowing principals across 21 sub-districts to input localized data while maintaining centralized benchmarking. Key findings reveal (1) discipline and personality collectively account for 45% of exemplary status determination, (2) cost-related factors show inverse correlation with remote school nominations, and (3) system implementation could reduce selection time by ≈68% compared to manual methods. This study contributes both a scalable framework for educational DSS and empirical data on vocational teacher excellence criteria in urban Indonesia.**

***Index Terms*—Decision support system, TOPSIS algorithm, exemplary teachers, teacher selection, vocational school.**

I. Introduction

Schools have structures that have certain positions, interact with each other, and carry out roles as expected according to their positions [1], [2], [3]. Educational decision-making encompasses all conceivable factors, including educational personnel, students, learning procedures, facilities, and financial resources [4], teachers are no exception. The quality of education is an important factor for individual and social development. Teachers are professional educators who are tasked with educating, teaching, evaluating students, guiding, training, and assessing [5]. Teachers are role models in the world of education who act as educators, mentors, assessors and role models for the students they teach [6]. Selecting exemplary teachers is important to ensure students receive effective, quality instruction. In selecting exemplary teachers at School Bekasi City, there is no system that can assist the school in calculating exemplary teacher assessments. To determine an exemplary teacher, the principal usually holds a meeting with several deputy principals. The deputy principal will help determine the exemplary teacher by looking at the teacher's attendance and the teacher's daily notes. Students were requested to offer comprehensive comments on their specific experiences, suggestions for enhancement, and acknowledgment of exceptional educators in the teaching and learning report [7]. Decisions involve many intangibles that need to be considered. In order to do something, decisions must be measured along with real, objective things. The things involved in the measurement must also be evaluated to see how well they serve the decision maker's goals [8], [9]. Then the results obtained in selecting exemplary teachers will be written on a piece of paper, which is vulnerable to damage or loss because there is no system-based report that can store the ranking of exemplary teachers. The absence of a DSS may influence the selection process of excellent educators to be less

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efficient and accurate in its calculations. What then happens is that the absence of a clear report on the ranking of exemplary teachers means that other teachers cannot know who is considered exemplary, giving rise to ambiguity and a lack of transparency in this process. To overcome the problems that have been explained, a method is required to facilitate the selection of excellent instructors, as assessed by the school principal. The selection of exemplary teachers in a school is still said to incorporate subjectivity, it entails selecting a primary or leader, with or without supporting data from outside sources [10]. Decision Support Systems (DSS) are computer-based platforms providing flexible tools to decision-makers that help them make decisions [11]. Decision support systems have always been recognized as valuable IT instruments across various domains, including cultural heritage [12], [13]. One of the most suitable DSS methods for giving employee (teachers) award is to apply [14], [15] the TOPSIS algorithm.

To prove that the TOPSIS method is still good for DSS research, researchers present the outcome of several studies in the format of curve diagrams in Python language. The DSS research trends with the TOPSIS Algorithm (2019–2024), as shown in Fig. 1.

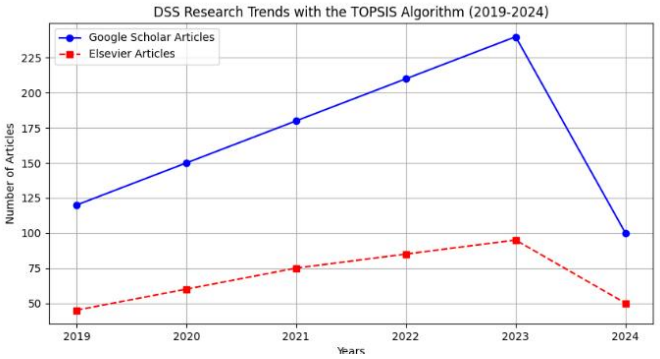

Fig 1. DSS research trends with the TOPSIS algorithm (2019–2024).

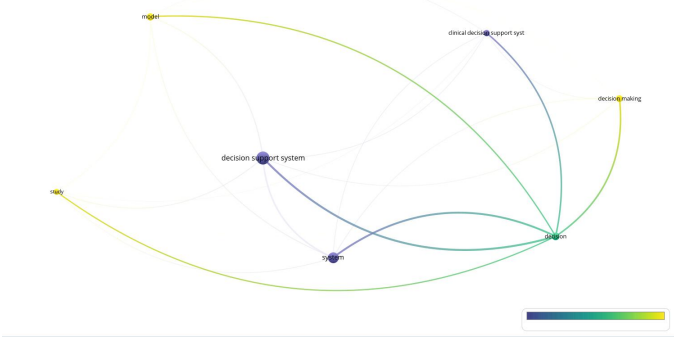

Fig 2. Viosviewer provides research on decision support systems.

II. Related Work

Multi-criteria decision-making frameworks serve as the platform upon which decision-support systems are built [16]. A system that provides assistance in making decisions for the purpose of conducting multimodal assessments of the synergistic effects of health and environmental initiatives [17]. A recommendation system (RS), is a decision assistance system that proposes [18]. The TOPSIS method efficiently addresses multi-dimensional evaluation problems by allowing for the distinct consideration of positive and negative indications [19], [20]. Despite significant variation in the relative weights of CV, SR, and MSC, the external weight integrated TOPSIS approaches still produced the precise best solution [21]. A decision matrix with a collection of alternatives and criteria is regarded as the initial stage for Multi-Criteria Decision-Making (MCDM) approaches such as TOPSIS [22]. The optimal choice is closest to the positive ideal solution (exemplary performance in all categories) and farthest from the negative ideal solution (worse performance in all criteria) [23]. Alternative measurement scale to replace the Likert scale if researchers want to obtain interval data processed using analysis techniques that require metric data [24]. While many studies focus on pre-launch usability assessments, post-launch evaluations are increasingly recognized for sustained competitiveness and customer satisfaction[25]. To measure the above criteria, the measuring tools used are as shown in the table below [26], [27], [28].

Table 1.
Rating Scale of Criteria

Criterion	Indicators	Rating Scale (1–5 Likert)
Discipline	Punctuality, attendance, rule compliance	1 = Very Poor, 2 = Poor, 3 = Fair, 4 = Good, 5 = Excellent
Travel Cost	Transportation efficiency, home-school distance	1 = Very High Cost, 2 = High Cost, 3 = Moderate, 4 = Low Cost, 5 = Very Low Cost
Personality	Communication, empathy, integrity	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree
Teaching Administration	Lesson plan completeness, documentation	1 = Not Fulfilled, 2 = Rarely Fulfilled, 3 = Partially Fulfilled, 4 = Mostly Fulfilled, 5 = Fully Fulfilled
Learning Achievement	Class average scores, student competency improvement	1 = Lowest 20%, 2 = Lower 40%, 3 = Middle 60%, 4 = Upper 80%, 5 = Top 10%

III. Research Method

Research conducted at one of the technical school in Bekasi City. A preliminary questionnaire, both structured and unstructured, was constructed based on a literature research and informal talks [29], and distributed the questionnaires [30] to teachers and students. With the research focus on a problem in selecting exemplary teachers at vocational schools in Bekasi City, namely still relying on data which can be said to be subjective (vague/biased), so it is necessary to carry out and develop research in selecting exemplary teachers based on objective [31] (transparent) data. The concept of the professional identity might be defined as the way in which educators perceive themselves in their roles as educators, depending on their interpretation of their experiences [32]. This study was conducted with a quantitative methodology based on a questionnaire according to prototype test results on a web-based system design. TOPSIS is the selected method that requires the shortest distance from the optimal solution and the greatest distance from the negative-ideal solution in a geometric context [33]. The objective of the TOPSIS technique is to establish a preference order that closely resembles the

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ideal solution, which is a theoretical solution characterized by maximal benefits and minimal costs of attributes or alternatives [26]. The decision support system for selection in this distinguished category employs TOPSIS (Technique for Order Performance by Similarity to Ideal Solution) method [34], [35], [36].

Research in this school aims to answer the problem that occurs, namely selecting exemplary teachers based on data, as in the research flow Fig. 3. The research method carried out by the researcher is a quantitative approach, which explains a picture with the support of data acquired from participants. The survey and questionnaire were created to address students' needs, requirements, and desired quality standards for online learning [29].

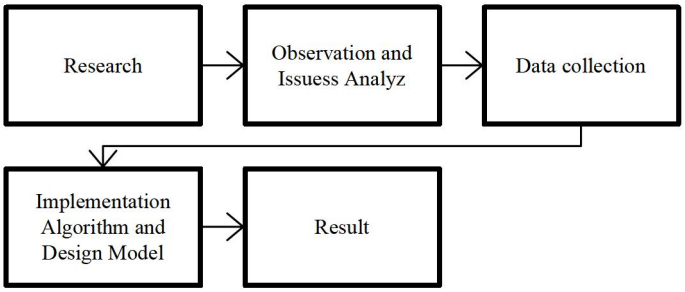

Fig 3. Research flow.

To carry out this approach, the researcher used system development with a prototype model, namely the problem analysis stage, design and implementation stage, and evaluation stage to obtain the expected system and simulate it with respondents in a prototype. The prototype model is a software development method that is widely used because developers and customers can engage with one another throughout the application development process [37]. With the prototyping technique, developers can create a prototype first before developing the actual system [38].

IV. RESULT

Research that uses a descriptive-quantitative approach results in a web-based system with the TOPSIS algorithm in the process of determining the best teacher; the results stages are as in the flow of the research above. The observation and problem analysis stages are the ones that occur in the research field, specifically at a vocational school in one of the cities in Bekasi, where the selection of exemplary teachers has not yet been carried out. The selection of the best teachers only looks at presence and social aspects in interactions with students, without any objective calculations, so it is said to be a problem in determining exemplary teachers.

In the data collection stages the researchers used literature study, observation, and interviews [39], to obtain a list of teachers who were used as samples for this research. The criteria encompass the economic background and financial status of the scholarship recipient, academic performance from prior educational stages, and any supplementary accomplishments as favourable attributes for evaluation [40]. The study aimed to determine the best-fit model for keeping quality teachers factored through outstanding teacher traits, personal response, and organizational environment [41]. However, in this study five criteria exist in deciding exemplary teachers, specifically discipline, travel costs, character, teaching administration, and learning achievements. The list of teachers used as sample tests for the TOPSIS algorithm is as shown Table 2.

Table 2.
Criteria Alternatives

Alternative	Criteria				
	C1	C2	C3	C4	C5
Amirullah, M.Pd	4	1	5	5	4
Auditya Ayu Dharmala, S.Pd	3	3	4	4	4
Cindy Yunita, S.S	4	3	4	4	4
Didi Saputra, S.Pdi	5	1	5	5	5
Eka Sasnata, S.T.	3	1	5	5	5
Faiz Rifki, ST	4	2	4	5	4
Kintan Aprilian Lestari, A.Md	3	3	4	4	4
Komariyatul Badriyah, S.Pd	5	1	5	4	4
Mujahidin, S.Pd	3	2	4	5	4
Musfi'ah, S.Pd	3	2	4	4	4
Sabilah Nurul Muawanah, S.Pd	4	1	4	4	4
Sunarni S. Pd.	4	2	5	3	4
Sunarto, S.T	4	1	5	5	5
Susan Kamelia, S.Pd	3	3	4	4	4

Table 3.
Criteria, Type, and Weight

Code	Criteria	Type	Weight
C1	Dicipline	Benefit	0.25
C2	Travel Cost	Cost	0.2
C3	Personality	Benefit	0.2
C4	Admnistration Teacher	Benefit	0.15
C5	Learning Achievements	Benefit	0.2

By implementing selection models derived from selection research in several areas [42], there are 5 criteria for determining an exemplary teacher in a school, as explained on Table 3 and with 5 stages of the TOPSIS algorithm.

A. Decision Matrix

$$X = \begin{vmatrix} A_{C1} & A_{C2} & A_{C3} & A_{C4} & A_{C5} \\ B_{C1} & B_{C2} & B_{C3} & B_{C4} & B_{C5} \\ C_{C1} & C_{C2} & C_z & C_{C4} & C_{C5} \end{vmatrix} \quad (1)$$

From (1), the decision matrix is obtained as follows:

$$X = \begin{bmatrix} 4 & 5 & 5 & 5 & 4 \\ 3 & 3 & 4 & 4 & 4 \\ 4 & 3 & 4 & 4 & 4 \\ 5 & 5 & 5 & 5 & 5 \\ 3 & 5 & 5 & 5 & 5 \\ 4 & 4 & 4 & 5 & 4 \\ 3 & 3 & 4 & 4 & 4 \\ 4 & 5 & 5 & 4 & 4 \\ 3 & 4 & 4 & 5 & 4 \\ 3 & 4 & 4 & 4 & 4 \\ 4 & 5 & 4 & 4 & 4 \\ 4 & 4 & 5 & 3 & 4 \\ 4 & 5 & 5 & 5 & 5 \\ 3 & 3 & 4 & 4 & 4 \end{bmatrix}$$

B. Normalization Matrix

In this normalization matrix, it can be said that the 2nd stage is with the following formula:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (2)$$

Then, a normalization matrix table (*R*) is produced as calculated using (2).

Table 4.
Normalization Matrix (*R*)

Alternative	C1	C2	C3	C4	C5
Amirullah, M.Pd	0.283	0.316	0.300	0.304	0.252
Auditya Ayu Dharmala, S.Pd	0.212	0.190	0.240	0.243	0.252
Cindy Yunita, S.S	0.283	0.190	0.240	0.243	0.252
Didi Saputra, S.Pdi	0.354	0.316	0.300	0.304	0.316
Eka Sasnata, S.T.	0.212	0.316	0.300	0.304	0.316
Faiz Rifki, ST	0.283	0.253	0.240	0.304	0.252
Kintan Aprilian Lestari, A.Md	0.212	0.190	0.240	0.243	0.252
Komariyatul Badriyah, S.Pd	0.354	0.316	0.300	0.243	0.252
Mujahidin, S.Pd	0.212	0.253	0.240	0.304	0.252
Musfi'ah, S.Pd	0.212	0.253	0.240	0.243	0.252
Sabilah Nurul Muawanah, S.Pd	0.283	0.316	0.240	0.243	0.252
Sunarni S. Pd.	0.283	0.253	0.300	0.182	0.252
Sunarto, S.T	0.283	0.316	0.300	0.304	0.316
Susan Kamelia, S.Pd	0.212	0.190	0.240	0.243	0.252

C. Weighted Decision Matrix (V)

The weighted decision matrix has been constructed by multiplying the normalised decision matrix by the corresponding weights of the decision matrix [22].

$$v_{ij} = w_j \, . \, r_{ij} \quad (3)$$

for the weighted automatic as per the formula above, by looking at Table 4, the values are obtained as seen in Table 5.

Table 5.
Weighted Matrix (*V*)

Alternative	C1	C2	C3	C4	C5
Amirullah, M.Pd	0.071	0.063	0.060	0.046	0.050
Auditya Ayu Dharmala, S.Pd	0.053	0.038	0.048	0.036	0.050
Cindy Yunita, S.S	0.071	0.038	0.048	0.036	0.050
Didi Saputra, S.Pdi	0.088	0.063	0.060	0.046	0.063
Eka Sasnata, S.T.	0.053	0.063	0.060	0.046	0.063
Faiz Rifki, ST	0.071	0.051	0.048	0.046	0.050
Kintan Aprilian Lestari, A.Md	0.053	0.038	0.048	0.036	0.050
Komariyatul Badriyah, S.Pd	0.088	0.063	0.060	0.036	0.050
Mujahidin, S.Pd	0.053	0.051	0.048	0.046	0.050
Musfi'ah, S.Pd	0.053	0.051	0.048	0.036	0.050
Sabilah Nurul Muawanah, S.Pd	0.071	0.063	0.048	0.036	0.050
Sunarni S. Pd.	0.071	0.051	0.060	0.027	0.050
Sunarto, S.T	0.071	0.063	0.060	0.046	0.063
Susan Kamelia, S.Pd	0.053	0.038	0.048	0.036	0.050

We got the weighted matrix (*V*) from 14 experiments, which is shown above. The above value was found by multiplying the weight value (*W*) by the normalization matrix value (*R*). Then, the next process will be the positive (*D*+) and negative (*D*-) ideal solutions.

D. Solution of Ideal (D+ and D-)

In determining this ideal solution, a formula is needed:

$$D_n^{+-} = \sqrt{(V)^2} \quad (4)$$

By looking at the formula above and looking at the Table of 5 weighted matrices, The values are derived as illustrated in Table 6.

Table 6.
Positive and Negative Ideal Values

Alternative	D+	D-
D1	0.033	0.028
D2	0.040	0.027
D3	0.026	0.032
D4	0.025	0.043
D5	0.043	0.025
D6	0.028	0.028
D7	0.040	0.027
D8	0.030	0.038
D9	0.041	0.022
D10	0.042	0.016
D11	0.037	0.020
D12	0.031	0.025
D13	0.031	0.031
D14	0.040	0.027

E. Preference and Ranking (C)

Preference and ranking is the final stage of the TOPSIS algorithm.

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (5)$$

Table 8.
Preference and Ranking

Alternative	Preferensi (*C*)	Rank
Amirullah, M.Pd	0.46	6
Auditya Ayu Dharmala, S.Pd	0.40	8
Cindy Yunita, S.S	0.55	3
Didi Saputra, S.Pdi	**0.63**	**1**
Eka Sasnata, S.T.	0.37	11
Faiz Rifki, ST	0.50	4
Kintan Aprilian Lestari, A.Md	0.40	8
Komariyatul Badriyah, S.Pd	0.56	2
Mujahidin, S.Pd	0.35	13
Musfi'ah, S.Pd	0.27	14
Sabilah Nurul Muawanah, S.Pd	0.35	12
Sunarni S. Pd.	0.44	7
Sunarto, S.T	0.50	5
Susan Kamelia, S.Pd	0.40	8

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The design model for selecting exemplary teachers in schools is outlined in Fig. 4.

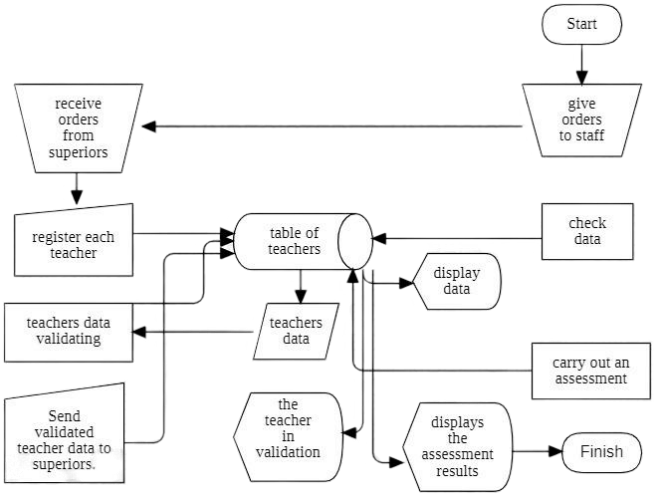

Fig 4. Model prototype design.

V. CONCLUSION

The teacher's position is crucial in the development of a nation's resources [43]. Looking at some of the problems explained in the introduction above, the data collection obtained is in the form of teacher data (alternative) as a sample from one of the schools in Bekasi city (Table 1). And the assessment criteria are Discipline (C1), Travel Cost (C2), Personality (C3), Administration Teacher (C4), and Learning Achievements (C5), and there are BENEFIT and COST. C1 has a weight of 25%, C2 weight of 20%, C3 20%, C4 15%, and C5 20%. From the calculation of stage 1, the normalized matrix C1 is 14.14, C2 is 15.18, C3 is 16.67, C4 is 16.46, and C5 is 15.84.

The next is the weighted matrix stage; after that, determining the negative and positive ideal solution values, where this value will ascertain the preference value, namely the D- value divided by the D- value plus D+, and the preference value of 0.63 and ranking 1 on behalf of Didi Saputra, S.Pdi. According to the researcher, this TOPSIS algorithm is in accordance with the criteria and assessments in making decisions for school leaders.

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