



Decision Support System for Proposing PIP Scholarship Recipients at SMKN 1 Borong Using TOPSIS Method

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ABSTRACT

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Decision support system is a computer-based system in solving management problems so as to produce the best alternative in making a decision. SMKN 1 Borong is a vocational high school located on Jl.Kihajar Dewantara, Satar Peot Village, Borong District, East Manggarai Regency, East Nusa Tenggara. The school was officially established on August 16, 2007 and currently has a total of 800 students. Based on the interview with Mr. Agustinus Galvan Dalory as the principal of SMK Negeri 1 Borong. SMK Negeri 1 Borong is one of the schools that receives the Indonesia Smart Program (PIP) scholarship assistance from the government. The school that handles this scholarship has difficulty selecting the names of scholarship recipients due to the large number of students. In addition, the selection of candidates for PIP scholarships at SMKN 1 Borong in assessing each criterion has not used a decision method. This can lead to errors in awarding the scholarship, resulting in inappropriate distribution of scholarships. To overcome these problems, a Decision Support System (SPK) is needed. One of the SPK methods that can be used is the Technique For Orders Preference By Similarity To Ideal Solution (TOPSIS) method. This method is used to select the best scholarship recipient from several prospective recipients who have their own advantages and disadvantages. The results of the decision support system are able to help the data management process and facilitate decision making.

1. Introduction

Scholarships are gifts in the form of financial assistance given to individuals, students or students who are used for the continuity of the education being pursued. Scholarships are defined as a form of appreciation given to individuals in order to continue their education to a higher level. The award can be in the form of certain access to an institution or an award in the form of financial assistance. Basically, a scholarship is income for the recipient [1], [2], [3]. The Indonesia Smart Program (PIP) is one example of the implementation of a policy by the Indonesian government to care for children in Indonesia to meet the educational needs

of school-age children who are considered economically disadvantaged [4]. This program provides cash assistance for education costs called the Smart Indonesia Card (KIP). This is evidence of the government's policy to realize the right of every citizen to obtain education services and improve the quality of life of the Indonesian people, as stipulated in the 1945 Constitution [5].

SMKN 1 Borong is a vocational high school located on Jl.Kihajar Dewantara, Satar Peot Village, Borong District, East Manggarai Regency, East Nusa Tenggara. The school was officially established on August 16, 2007 and currently has a total of 800 students divided into three educational levels, namely classes X, XI, and XII. As an educational institution. SMK Negeri 1 Borong not only focuses on developing students' vocational competencies, but also seeks to support those in need of financial assistance through scholarship programs. One of the scholarship programs that students receive is the Indonesia Smart Program (PIP), which is intended to help students from underprivileged families to continue their education. In 2022, SMKN 1 Borong had only 200 students who received the Indonesia Pintar Program (PIP) scholarship. The scholarship recipients consisted of 13 grade X students, 25 grade XI students, and 162 grade XII students. The number of scholarship recipients was relatively small because the number of students at SMKN 1 Borong that year was very small. The number of students receiving PIP scholarships increased to 206 in 2023, with 84 students from class X, 54 students from class XI, and 68 students from class XII. This increase shows that greater attention has been given to students' needs for academic support, especially for students who come from economically disadvantaged backgrounds.

The school that handles this scholarship had difficulty selecting the names of the recipients due to the large number of students. This selection process requires accuracy and a lot of time because student data is calculated one by one. In addition, the selection of candidates for PIP scholarships at SMKN 1 Borong in assessing each criterion has not used a decision method. This can lead to errors in awarding the scholarship, resulting in inappropriate scholarship distribution.

To overcome these problems, it is necessary to have a Decision Support System (SPK) that can assist in making decisions in awarding PIP scholarships. One of the SPK methods that can be used is the Technique For Orders Preference By Similarity To Ideal Solution (TOPSIS) method [6], [7]. This method is used to select the best scholarship recipient from several prospective recipients who have their own advantages and disadvantages. The TOPSIS method is one of the multicriteria decision-making methods first introduced by Yoon and Hwang in 1981 [8], [9], [10], [11]. This method is one of the methods that is widely used to solve practical decision making. TOPSIS has a concept where the selected alternative is the best alternative that has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

2. Research Methods

This part of the research was conducted using the TOPSIS method to create a decision support system for PIP scholarship recipients at SMKN 1 Borong. The TOPSIS procedure in general consists of stages and formulas which will be explained as below [12],[13-19]:

1. Normalization

For criteria that are benefits

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \quad (1)$$

For criteria that are cost

$$r_{ij} = \frac{x_{ij}}{\min(x_{ij})} \quad (2)$$

Explanation of formula:

- r_{ij} : This value is in the range of 0 to 1. Where 0 means the performance of the registrar on that criterion is the lowest, while 1 means the performance of the registrar on that criterion is the highest.
- x_{ij} : The original value (raw score) obtained by the applicant i on the criteria.
- $\max(x_{ij})$: The maximum score of all applicants on the criterion.
- $\min(x_{ij})$: The minimum score of all applicants in the criteria.
- i : Index that represents the applicant (alternative).

2. Normalization Result

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

Explanation of Formulation:

- v_{ij} : Weighted normalized value for applicant i on criteria.
- r_{ij} : Normalized value for i registrar on j criteria, obtained from the previous normalization.
- w_j : The weight for criterion j , reflects the level of importance of the criterion.

3. Positive Ideal Distance Calculation

$$D_i^+ = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^+)^2} \quad (4)$$

Explanation of Formulation:

- D_i^+ : Positive ideal distance for alternative i (registrari).
- v_{ij} : Weighted normalization value for i applicants on j criteria (normalization results that have been multiplied by weights).
- v_j^+ : Positive ideal solution for criteria j (maximum value of all applicants on criteria j).
- m : Number of criteria.

4. Calculation of Negative Ideal Distance

$$D_i^- = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^-)^2} \quad (5)$$

Explanation of Formulation:

- D_i^- : Negative ideal distance for alternative i (i registrar).
- v_{ij} : Weighted normalization value for i applicants on j criteria (normalization results that have been multiplied by weights).

- c. v_j^- : Negative ideal solution for criteria j (minimum value of all applicants on criteria j).
- d. m : Number of criteria.

5. Final Assessment

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (6)$$

Explanation of Formulation:

- a. C_i : Preference score for the alternatives (applicants).
- b. D_i^- : Distance of the i applicant from the negative ideal solution.
- c. D_i^+ : Distance of the i registrar from the positive ideal solution.

3. Results and Discussion

3.1 System Implementation

The implementation of the system will be limited in accordance with the provisions discussed in the previous chapters, which include information and at this stage of the discussion will be explained about the appearance of each user interface page.

3.2 Registration Data Page

The Registrar Data page displays all data on prospective selection participants that have been inputted into the system. This table makes it easy for the admin to monitor and verify the information of each participant thoroughly.



No	Nama	Memiliki kartu KIP	Memiliki kartu KKs atau PKH	Pendapatan Orang Tua/Wali	Nilai Akademik	Kelas	Prestasi	Tanggungan orang tua/wali	status keluarga
1	ROSSETTA GANGUL	Ya	Ya	10000000.0	85.0	12	3x	2x	keluarga utuh
2	Benediktus Agri Balu	Ya	Tidak	10000000.0	85.0	12	1x	2x	yatim piatu
3	Filomena Daeng	Ya	Ya	10000000.0	85.0	12	1x	2x	keluarga utuh
4	Stefanus Obe	Tidak	Tidak	10000000.0	90.0	12	1x	3x	yatim piatu
5	Maria Retna Lesteri	Tidak	Tidak	15000000.0	88.0	12	2x	> 3x	keluarga utuh
6	Diana Mirawati Adi	Ya	Tidak	10000000.0	78.0	12	2x	2x	yatim/piatu
7	Veronika Janun	Ya	Tidak	10000000.0	80.0	12	2x	2x	keluarga utuh
8	Yohanes Don	Ya	Ya	15000000.0	80.0	12	2x	3x	keluarga utuh

Figure 1. Registration Data Page

3.3 Criteria Data Page

The Criteria Data page can be accessed by prospective applicants and registrants without the need to log in first. This page presents information about all criteria used in the selection process.



No	Kriteria	Jenis	Atribut	Nilai
1	Memiliki kartu KIP	Benefit	Tidak Ya	1 2
2	Memiliki kartu KIS atau PKH	Benefit	Tidak Ya	1 2
3	Pendapatan Orang Tua/Wali	Cost	Input langsung (0.0 - 10000000.0)	-
4	Nilai Akademik	Benefit	Input langsung (0.0 - 10000000.0)	-
5	Kelas	Benefit	10 11 12	1 2 3
6	Prestasi	Benefit	1x 2x 3x > 3x	1 2 3 4

Figure 2. Criteria Data Page

3.4 Final Result Data Page

The Final Result Data page displays the output of the TOPSIS method calculation. This table contains columns Rank, Name, D⁺ (Positive), D⁻ (Negative), and Preference Value which are used to determine the priority order of participants based on the highest value.



Ranking	Nama	Nilai Preferensi
1	IRINA ANA DIAN	0.5328
2	MARIA SUSANTI KULWANGI	0.5279
3	HILARIANUS HAMBUR	0.5076
4	Gordonus Nadi	0.504
5	Paula Simi	0.4436
6	Kristina Wotu	0.4063
7	MARIA KLARET ANDRIANU LOJENG	0.3881
8	Salvatus Agang	0.3723
9	Emilia Cinta Enes	0.3562
10	Azkan Hamdi Fatwa	0.3034
11	Falerius Joine Putra	0.0832

Figure 3. Final Result Data Page

3.5 Blackbox Testing

Black Box Testing is a software testing method used to evaluate the functionality of a system without having any knowledge of the internal code structure or implementation logic [20-22]. This type of testing focuses solely on the inputs and expected outputs to determine whether the system behaves as intended based on its functional specifications. The internal workings of the system are not considered during the testing process. In this research, system testing was carried out to determine whether the designed system functions properly. The testing was conducted using the Black Box Testing method, which focuses on verifying the functions provided in the system, such as data input, decision-making processes, and output display, without examining the internal code or program structure.

3.5.1 Login Page Testing Scenario

In table 1 is a login function where the test results are in accordance with what the tester expects.

Table 1. Login Page Testing Scenario

Page	Test Scenario	Expected Result

Login	Admin Enter username and password then click the login button to enter the system.	Successfully enter the system. The system will display the dashboard and display pages that can only be accessed by the admin.
	Admin enters a username and password that does not match	Unable to log in as admin

3.5.2 Dashboard Page Testing Scenario

In table 2 is a test phase on the dashboard page when the user has entered the dashboard page. Where the test results are in accordance with the expected pa.

Table 2. Dashboard page test scenario

Page	Test Scenario	Expected Results
Dashboard	User enters the dashboard page	Users can see some students who get scholarships, and some who don't get scholarships.

3.5.3 Registration Page Testing Scenario

In table 3 is a test phase on the registration page, when the user tries to register himself on the registration page, where the test results are in accordance with what is expected.

Table 3. Registration page test scenario

Page	Test Scenario	Expected Results
registration	user enters the registration page and enters all the data requested by the system	registrant data is successfully added to the database and can be seen on the registrant data page.

3.5.4 Registration Data Page Testing Scenario

In table 4 is a test phase on the registrant data page, after the user registers himself on the registration page, it is expected that the data can be seen on the registrant data page, where the test results are in accordance with what is expected.

. Table 4. Registrant data page test scenario

Page	Test scenario	Expected Result
Registrant Data	User enters the registrant data page	Users can see all data on students who register themselves

3.5.5 Criteria Page Scenario

In table 5 is a test phase on the criteria page, after the user enters the criteria page, it is expected that the user can see all the criteria data needed to register. Where the test results are in accordance with what is expected.

Table 5. Criteria page test scenario

Page	Test Scenario	Expected Result
criteria	user enters the criteria page	user can see all criteria data needed for registration

4. Conclusion

Based on the results of the research and system testing that have been carried out, several conclusions can be drawn. The process of designing and developing the system began with interviews, observations, and data collection, followed by data analysis and implementation. The decision support system for selecting recipients of the Smart Indonesia Program (PIP) scholarships at SMKN 1 Borong was developed using the TOPSIS method, which was applied based on the creation of an event list tailored to user requirements. This system was designed to assist the school in managing PIP scholarship recipient data more effectively and efficiently. By utilizing computerized data processing, including the input and upload of student data, the system facilitates the selection process and helps the school in determining eligible PIP scholarship recipients more easily.

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Reference

- [1] Christiana, A. D., and Mailoa, E. 2022. "Website-Based Employee Performance Appraisal Decision Support System Using the TOPSIS Method". *Aiti*, 19(1), 31-47. <https://doi.org/10.24246/aiti.v19i1.31-47>.
- [2] Area, U. M. 2023. "Implementation of Indonesian Program Policy". Banjarnahor, J. 2022. "Decision Support System for Determination of Computer Laboratory Assistant with TOPSIS Method Case Study of AMIK MBP Laboratory". *LOFIAN: Journal of Information and Communication Technology*, 1(2), 29-37. <https://doi.org/10.58918/lofian.v1i2.172>

-
- [3] Dina Aqmila 2022. "Design of Python Programming Language Learning Media Using SCRATCH Application for Junior High School Students". Thesis, 1-51.
 - [4] Fauzi, J. R. 2020. "Algorithms and Flowcharts in Solving a Problem Compiled by Janabadra University Yogyakarta 2020". *Journal of Informatics Engineering*, (20330044), 4-6.
 - [5] Scientific, J., and Education, W. 2024. "1, 2 1,2", 10(11), 799-811. Mardayatmi, S., Defit, S., et al. 2021. "Decision Support System for School Committee Assistance Recipients Using the Topsis Method". *Journal of Information Systems and Technology*, 3, 134-141.
 - [6] Zamjani, I. 2019. "Implementation of the Indonesia Smart Program for Regular Indonesia Smart Card Recipients: Study in Four Presidential Working Visit Areas in 2017". *Journal of Education Policy Research*, 11(2), 64-82. <https://doi.org/10.24832/jpkp.v11i2.225>.
 - [7] Zen, M., Supiyandi, S., et al. 2022. "Decision Support System for Study Tour Student Selection Using TOPSIS Method". *JURIKOM (Journal of Computer Research)*, 9(6), 2141. <https://doi.org/10.30865/jurikom.v9i6.5152>.
 - [8] Septiawati, S. E., Prasetijowati, T., et al. 2022. "Analysis of the Implementation of the Indonesia Pintar (Pip) Program from the Perspective of Good Governance in the Madrasah Environment". *Journal of Social and Political Sciences (JISIP)*, 11(3), 267-274. <https://doi.org/10.33366/jisip.v11i3.2556>.
 - [9] Syah, M. Y. A.-H., Sanjaya, M. R., et al. 2023. "Decision Support System by Applying TOPSIS Method to Determine the Best Student". *Journal of Business Information Technology and Systems*, 5(2), 149-154. <https://doi.org/10.47233/jteksis.v5i2.794>.
 - [10] Yani, Z., Gusmita, D., et al. 2022. "Decision Support System for Employee Acceptance". *Journal of Science and Social Research*, 5(2), 205-210.
 - [11] Nurokhmah 2021. "Smart Indonesia Program (PIP): Implementation of Welfare Policy in Efforts to Increase Education Participation Rates". *Paradigma Journal: Multidisciplinary Journal of Indonesian Postgraduate Students*, 2(1), 37-48.
 - [12] Rohaeni, N. E., and Saryono, O. 2018. "Implementation of the Smart Indonesia Program (PIP) Policy through the Smart Indonesia Card (KIP) in an Effort to Equalize Education". *Journal of Education Management and Administration Review*, 2(1), 193-204.
 - [13] I. P. A. E. D. Udayana, I. G. A. Indrawan, and I. P. D. G. A. Putra, "Decision Support System for Sentiment Analysis of Youtube Comments on Government Policies," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 5, no. 1, pp. 27–37, 2023, doi: 10.47709/cnahpc.v5i1.1999.
 - [14] I. G. I. Sudipa *et al.*, *METODE PENELITIAN BIDANG ILMU INFORMATIKA (Teori & Referensi Berbasis Studi Kasus)*. PT. Sonpedia Publishing Indonesia, 2023.
 - [15] I. G. I. Sudipa *et al.*, *PENERAPAN SISTEM INFORMASI DI BERBAGAI BIDANG*. PT. Sonpedia Publishing Indonesia, 2023.
 - [16] A. S. Kusuma, I. M. Sutajaya, and I. G. P. Sudiarta, "Online Learning Applications in Shaping Entrepreneurial Character: A Systematic Review," *Utamax J. Ultim. Res. Trends Educ.*, vol. 4, no. 2, pp. 160–167, 2022.
 - [17] P. Sugiartawan, I. M. Yudiana, and P. I. Prakoso, "Group Decision Support System

-
- Fuzzy Profile Matching Method With Organizational Citizenship Behaviour," *IJCCS (Indonesian J. Comput. Cybern. Syst.,* vol. 15, no. 4, 2021.
- [18] Y. R. Dewi, N. W. S. Saraswati, M. O. E. Monny, I. B. G. Sarasvananda, and I. G. Andika, "Sentiment Analysis of the Relocation of the National Capital on Social Media X," *Sink. J. dan Penelit. Tek. Inform.,* vol. 9, no. 2, pp. 625–636, 2025.
- [19] P. Sugiartawan, I. G. I. Sudipa, and I. K. A. G. Wiguna, "GDSS Development of Bali Tourism Destinations With AHP and Borda Algorithms Based on Tri Hita Karana," *IJCCS (Indonesian J. Comput. Cybern. Syst.,* vol. 16, no. 3, pp. 271–280, 2022, doi: 10.22146/ijccs.76605.
- [20] Hanifah, U., Alit, R., et al. 2016. "The Use of the Black Box Method in Testing the Inbound and Outbound Mail Information System". *Scan: Journal of Information and Communication Technology*, 11(2). <https://doi.org/10.33005/scan.v11i2.643>.
- [21] Nurokhmah, "Smart Indonesia Program (PIP): Implementation of Welfare Policy in an Effort to Increase Education Participation Rate," *J. Paradig. J. Multidisciplinary Mhs. Postgraduate Program*, vol. 2, no. 1, pp. 37-48, 2021.
- [22] E. Nurelasari and E. Purwaningsih, "Decision Support System for Best Housing Selection with TOPSIS Method," *J. Sist. and Technol. Inf.,* vol. 8, no. 4, pp. 317, 2020.