NATIONAL INTRA-SCHOOL STUDENT ORGANIZATION FORUM SCHOLARSHIP ACCEPTANCE WITH THE TOPSIS METHOD

Febri Yolanda Silalahi[1], Nabilla Pramudya Wardhani[2], Rajendra Nandana Hernanto[3], Muhamad Awiet Wiedanto Prasetyo[4*]

Information System, Telkom University[1234]

febriysilalahi@student.telkomuniversity.ac.id[1]

nabillapramudya@student.telkomuniversity.ac.id[2]

rajendranandana@student.telkomuniversity.ac.id[3]

awietmwp@telkomuniversity.ac.id[4]

Abstract

This study aims to apply the TOPSIS method as an effective tool in the decision-making system for selecting scholarship recipients. The scholarship selection process is an important step in ensuring that institutions select potential recipients who fit their criteria. In this study, researchers identified criteria that were relevant in the selection of scholarship recipients, such as the average student report card scores, student positions in student council, student experience, and student achievements. The data obtained from each vendor is converted to a relative scale using normalization techniques. The TOPSIS method was then applied to obtain the relative ranking of each student. In this method, students who have the closest distance to the positive ideal solution (which has the highest score on all criteria) and the farthest distance from the negative ideal solution (which has the lowest score on all criteria) will be selected as the best choice. This research was conducted using a case study on the selection process for FON scholarship recipients at the Telkom Institute of Technology, Purwokerto. The results show that the TOPSIS method provides a consistent and objective rating for each student. Thus, the TOPSIS-based decision-making system can assist management in selecting students who best fit the institution's criteria. In addition, we also conducted a sensitivity analysis to test the reliability of the scholarship recipient selection results by considering the variation in the weight of the criteria. The results show that changing the weight of the criteria can affect ranking, allowing management to consider different preferences with the final result being the highest preference value, namely 0.844901. This research makes an important contribution in the field of decision-making systems and selection of scholarship recipients.

Keywords *Scholarship, Decision Making Process, TOPSIS*

A. Introduction

Currently, there is no doubt that education is crucial for the advancement of individuals and nations as a whole. Education plays a vital role, making the provision of scholarships for outstanding students in senior high schools, vocational schools, and equivalent institutions essential [1]. Scholarships are intended to encourage students to continue their education and

strive for academic excellence. These awards can take the form of financial assistance or special access to educational institutions to support academic activities. To date, the government has made efforts to reduce the number of academically promising students who drop out of school due to economic reasons. To address this issue, the government has implemented strategic measures by providing scholarships to assist with tuition fees. Although this initiative may not cover all students in Indonesia, it is expected to reduce the number of students unable to attend school due to financial constraints. The success of scholarships is not solely determined by the amount of financial aid provided but also by the effectiveness of the scholarship in assisting the most disadvantaged students. Conversely, it has been demonstrated that scholarships offer benefits that lead to improved academic performance among students [2].

Telkom University Purwokerto is a higher education institution located in Purwokerto with a focus on technology education. Each year, the campus launches both internal and external scholarship programs. However, the increasing number of applicants and the limited quota available have made the scholarship selection process more competitive. To address this challenge, a dedicated system is required to manage the scholarship program known as the National Intra-School Student Organization Forum Scholarship Program (FON). This program is specifically designed for members of Intra-School Student Organizations (OSIS) across Indonesia to support their pursuit of higher education.

A data processing method is required during the candidate selection process to align with current criteria. The TOPSIS method is a decision support system method [1]. This method is based on the idea that the selected alternative is the best alternative, determined by the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution [3]. The positive ideal solution represents the best values obtained for each attribute [4]. Therefore, this method is considered the most effective for decision-making. The objective of this study is to utilize the TOPSIS method to develop a decision support system for the FON 2023 scholarship selection process. This method was chosen due to its straightforward computational concepts and processes [3]. Additionally, the system will be web-based, making it easier for users to access. The Scholarship Selection Decision Support System will assist the FON 2023 scholarship selection process by applying the TOPSIS method and incorporating predefined criteria, including average report card grades, parental income, positions held in OSIS, achievements, and student experience.

B. Literature Review and Hypothesis Development

Scholarships are financial aid awards provided to individuals with the aim of supporting the continuation of their education [5]. Scholarships can be offered by governments, corporations, or foundations. These awards typically fall into one of two categories: free grants or awards with service obligations (commonly referred to as bonded scholarships) after graduation [6]. Scholarships are divided into several categories as follows [7], Assistance Scholarships is type of scholarship provides funding for academic activities to underprivileged but high-achieving students. Scholarship providers establish specific criteria for recipients who face financial difficulties, such as insufficient parental income to support further education, the number of siblings also attending school, living expenses, and other related factors. Merit Scholarships type is based on the overall accumulation of academic achievements. Examples include Grade Point Average (GPA), FON awards, and others. Athletic Scholarships are awarded to athletes who meet specific standards, granting them opportunities to compete at the university level. Instead of providing monetary assistance, these scholarships offer free education opportunities until the completion of their studies. Full Scholarships awarded to recipients to cover all their academic needs. This includes covering tuition fees, books, and living expenses. However, such scholarships are highly competitive, and only a limited number of individuals can receive them.

Several scholarships are offered by the Telkom Institute of Technology Purwokerto, including the FON Scholarship, which is highly sought after by high school and vocational school students. The FON Scholarship is a college scholarship specifically designed for student council (OSIS) leaders across Indonesia. This program aims to support educational advancement in Indonesia, providing OSIS activists with opportunities to pursue higher education while enhancing their leadership capacities. A Decision Support System (DSS) is an approach to organizing data-driven information [8]. This system aids decision-making by utilizing well-integrated criteria that interact effectively with one another [8]. Flexibility in usage, learning processes, and the system referred to as the Decision Support System are all components used to build this framework [7]. Due to its structure, DSS is closely associated with concepts of information systems and analytical models [9]. These models are designed to provide decision-makers and professionals with accurate and reliable information [9].

The decision-making process consists of problem definition, model exploration, experimentation, and implementation of the selected model [10]. In the first step, the problem is

defined by setting project targets, identifying how they can be achieved, and categorizing issues based on their resolution needs [10]. In the next phase, models are evaluated to determine which can provide the desired output, incorporating model variables for outcome prediction [10]. The subsequent stage involves experimentation to select the best variables and alternatives. Finally, the chosen model is implemented, and a sensitivity analysis is conducted to understand the impact of variable changes on the outcomes [10]. The TOPSIS method, part of Multi-Attribute Decision Making (MADM), identifies the best solution by determining how close a value is to the positive ideal solution and how far it is from the negative ideal solution [9]. Alternatives are ranked based on their relative closeness to the positive ideal solution [9].

TOPSIS is a multi-criteria method that can be used to find an optimal solution from a set of alternatives by minimizing the distance between the values of the positive and negative ideal solutions [11]. The principle of alternatives is employed to find the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution from a geometric perspective using Euclidean distance [12]. Therefore, this framework can be utilized to determine the relative proximity between alternatives and the ideal solution [13]. The interrelated steps for determining alternative decisions using the TOPSIS method can be carried out as follows [14]:

Creation of a normalized pairwise comparison matrix

$$r_{ij} = \frac{x_{ij}}{\sqrt{\Sigma_{i=1}^{m} x_{ij^2}}}$$

Explanation:

- *rijr_{ij}rij: Normalized decision matrix*
- *xijx_{ij}xij: Decision matrix*
- *mmm: Number of alternatives*
- *iii: Row (alternatives)*
- *jjj: Column (criteria)*

Creation of a weighted normalized decision matrix:

$$y_{ij} = w_j \ . r_{ij}$$

With i = 1, 2,...,m and j=1,2,..., n

Explanation:

- *yijy_{ij}yij: Weighted normalized matrix*

- *rijr_{ij}rij: Normalized decision matrix*
- *wjw_jwj: Weight of the jjj-th criterion*

Determination of the positive ideal solution matrix and the negative ideal solution matrix:

$$(A^+) = (y^+_1, y^+_1, \ldots, y^+_n)$$
$$(A^-) = (y^-_1, y^-_1, \ldots, y^-_n)$$

Explanation:

- y^+_1 = *Max$_i$ y_{ij} for benefit attributes*
- y^-_1 = *Max$_i$ y_{ij} for cost attributes*

Calculation of the distance between each alternative value and the positive/negative ideal solution matrices:

$$D_i^+ = \sqrt{\Sigma_{j=1}^n (y_{ij} - y^+_j)^2}$$
$$D_i^- = \sqrt{\Sigma_{j=1}^n (y_{ij} - y^-_j)^2}$$

Explanation:

- D_i^+ = *Distance of the iii-th alternative from the positive ideal solution*
- D_i^- = *Distance of the iii-th alternative from the negative ideal solution*

Calculation of preference values for each alternative:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

Explanation:

- V_i = *Closeness of each alternative to the ideal solution*
- D_i^+ = *Distance to the positive ideal solution*
- D_i^- = *Distance to the negative ideal solution*

A Decision Support System (DSS) is an implementation of decision-making theory derived from established methods such as management science and operations research. The primary goal of a DSS is to assist users in making better decisions by providing information, guidance, predictions, and recommendations for solutions. Unlike traditional manual processes that relied

on calculating minimum, maximum, or optimal values, modern intelligent computer systems can solve problems in a matter of minutes.

C. Research Method

This research was conducted using a quantitative method, focusing on a specific sample. The data were collected and analyzed quantitatively to test and validate the pre-established hypotheses. The data collection technique employed in this study involved interviews with the Admissions Office (PMB) at Telkom University Purwokerto. The required data pertained to new students applying for the FON Telkom University Scholarship in 2024. Below are the steps outlined in the research process:

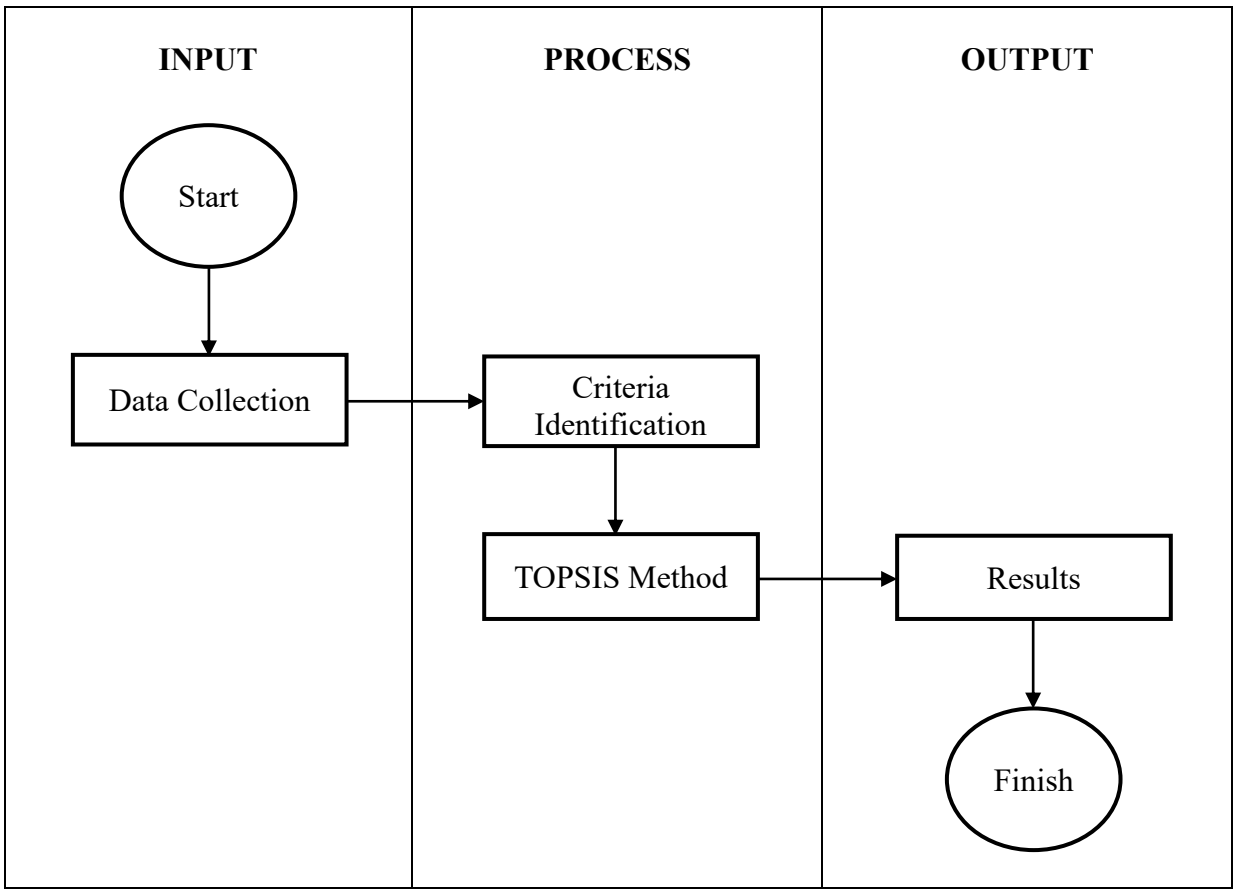

Figure 1. Activity Design

Data collection is the initial stage where the activity design begins. This step involves gathering data on prospective new students applying for the FON Telkom University Scholarship

2024. Criteria identification serves as a reference point for assessing the selected samples and assigning scores to each predetermined criterion using the TOPSIS Method. Performing calculations using the TOPSIS method for the scholarship recipient criteria enables the determination of the selected candidates eligible for the Telkom University Scholarship. This process includes the following stages Calculating Normalized Weights, Calculating Preference Values & Determining Positive and Negative Solutions. The ranking results represent the final stage in determining the selected students for scholarship acceptance. These results are derived from the calculations conducted. At this stage, TOPSIS is used to choose the alternatives, where the selected alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution [15].

D. Discussion

This section provides a general explanation of how the comparative values for each alternative are calculated against the predetermined criteria using the TOPSIS method. Based on several calculated values, the author applies the TOPSIS method as a decision-making tool to determine the most suitable students to receive the FON scholarship. The calculations obtained by the author are us determining the criteria for consideration. Essential to first establish various criteria that serve as the basis for consideration and are relevant to the case being addressed. The criteria used in selecting the recipients of the FON Scholarship 2023 using the TOPSIS method are as follows:

a. *Criterion 1 (C1): Students average report card scores*
b. *Criterion 2 (C2): Students positions in the OSIS organization*
c. *Criterion 3 (C3): Students organizational or leadership experience*
d. *Criterion 4 (C4): Students achievements*

Additionally, the alternatives selected as samples for the FON Scholarship 2023 recipient calculation are as follows, Alternative 1: A1, Alternative 2: A2, Alternative 3: A3, Alternative 4: A4, Alternative 5: A5, Alternative 6: A6, Alternative 7: A7, Alternative 8: A8, Alternative 9: A9, Alternative 10: A10. After defining the assessment criteria, the next step is to determine the preference weights for each criterion. This process is based on the relative importance of one criterion compared to another. The comparison values between criteria are measured by their level of importance, which can be represented as follows Very Low Importance = 1, Low Importance = 2, Moderate Importance = 3, High Importance = 4, Very High Importance = 5.

From these values, it can be concluded that preference scores range from 1 to 5. The higher the preference score of a criterion, the greater its importance in influencing a decision. The preference weights for the criteria are determined based on interviews with the PMB Telkom University team. Once the weight and preference standards are established, the alternatives are evaluated against the predefined criteria. The preference weights for each criterion are as follows:

a. *Criterion 1 (C1): Student's average report card grade = 5*
b. *Criterion 2 (C2): Student's position in the student organization (OSIS) = 4*
c. *Criterion 3 (C3): Student's organizational/experience background = 3*
d. *Criterion 4 (C4): Achievements attained by the student = 4*

For the position, organizational/experience background, and achievements, numerical conversions are applied to simplify the TOPSIS calculation:

a. *Position in OSIS: Core Management=50, Division Leader=30, Member=20*
b. *Experience: 1 experience=10, 2 experiences=20, 3 experiences=30, 4 experiences=40*
c. *Achievements: 1–4 achievements = 10, 5–8 achievements = 20, 9–12 achievements = 30, 13–16 achievements = 40*

Table 1. Decision

	C1	C2	C3	C4
A1	91,11	50	10	40
A2	85,27	20	10	0
A3	85,70	30	10	10
A4	86,00	50	10	0
A5	81,92	50	10	0
A6	84,62	50	10	10
A7	92,52	30	20	20
A8	86,76	50	10	0
A9	93,21	50	20	20
A10	81,00	50	10	20

After constructing the decision matrix shown in Table 1. Decision, the next step is to normalize the values in the decision matrix. Each alternative for the given criteria can be calculated using the formula established, yielding the values of each alternative for every criterion, as shown in the table Table 2. Alternative Result

Table 2. *Alternative Result*

	C1	C2	C3	C4
A1	1,049521	1,162791	0,833333	3,333333
A2	0,982249	0,465116	0,833333	0
A3	0,987202	0,697674	0,833333	0,833333
A4	0,990658	1,162791	0,833333	0
A5	0,943659	1,162791	0,833333	0
A6	0,974761	1,162791	0,833333	0,833333
A7	1,065764	0,697674	1,666667	1,666667
A8	0,999413	1,162791	0,833333	0
A9	1,073712	1,162791	1,666667	1,666667
A10	0,933061	1,162791	0,833333	1,666667

Thus, the normalized values (R) are obtained as follows:

$$R = \begin{pmatrix} 1{,}049521 & 1{,}162791 & 0{,}833333 & 3{,}333333 \\ 0{,}982249 & 0{,}465116 & 0{,}833333 & 0 \\ 0{,}987202 & 0{,}697674 & 0{,}833333 & 0{,}833333 \\ 0{,}990658 & 1{,}162791 & 0{,}833333 & 0 \\ 0{,}943659 & 1{,}162791 & 0{,}833333 & 0 \\ 0{,}974761 & 1{,}162791 & 0{,}833333 & 0{,}833333 \\ 1{,}065764 & 0{,}697674 & 1{,}666667 & 1{,}666667 \\ 0{,}999413 & 1{,}162791 & 0{,}833333 & 0 \\ 1{,}073712 & 1{,}162791 & 1{,}666667 & 1{,}666667 \\ 0{,}933061 & 1{,}162791 & 0{,}833333 & 1{,}666667 \end{pmatrix}$$

After constructing the normalized matrix, the next step involves multiplying the values in the normalized matrix by the preference weights assigned to each criterion.

$y_{11} = wl \times r11 = 5 \times 1{,}049521 = 5{,}247607$

$y_{12} = wl \times r12 = 4 \times 1{,}162791 = 4{,}651163$

$y_{13} = wl \times r13 = 4 \times 0{,}833333 = 2{,}5$

$y_{14} = wl \times r14 = 3 \times 3{,}333333 = 13{,}33333$

Thus, the matrix Y is obtained as follows:

$$Y = \begin{pmatrix} 5{,}247607 & 4{,}651163 & 2{,}5 & 13{,}33333 \\ 4{,}911244 & 1{,}860465 & 2{,}5 & 0 \\ 4{,}93601 & 2{,}790698 & 2{,}5 & 3{,}333333 \\ 4{,}953289 & 4{,}651163 & 2{,}5 & 0 \\ 4{,}718296 & 4{,}651163 & 2{,}5 & 0 \\ 4{,}873806 & 4{,}651163 & 2{,}5 & 3{,}333333 \\ 5{,}328818 & 2{,}790698 & 5 & 6{,}666667 \\ 4{,}997063 & 4{,}651163 & 2{,}5 & 0 \\ 5{,}368559 & 4{,}651163 & 5 & 6{,}666667 \\ 4{,}665307 & 4{,}651163 & 2{,}5 & 6{,}666667 \end{pmatrix}$$

Determining the positive ideal matrix A+

Y_1^+ = max {5,247607; 4,911244; 4,93601; 4,953289; 4,718296; 4,873806; 5,328818; 4,997063; 5,368559; 4,665307} = 5,368559

Y_2^+ = max {4,651163; 1,860465; 2,790698; 4,651163; 4,651163; 4,651163; 2,790698; 4,651163; 4,651163; 4,651163} = 4,651163

Y_3^+ = max {2,5; 2,5; 2,5; 2,5; 2,5; 2,5; 5; 2,5; 5; 2,5} = 5

Y_4^+ = max {13,33333; 0; 3,333333; 0; 0; 3,333333; 6,666667; 0; 6,666667; 6,666667} = 13,33333

Determining the negative ideal matrix A−

Y_1^- = min {5,247607; 4,911244; 4,93601; 4,953289; 4,718296; 4,873806; 5,328818; 4,997063; 5,368559; 4,665307} = 4,665307

Y_2^- = min {4,651163; 1,860465; 2,790698; 4,651163; 4,651163; 4,651163; 2,790698; 4,651163; 4,651163; 4,651163} = 1,860465

Y_3^- = min {2,5; 2,5; 2,5; 2,5; 2,5; 2,5; 5; 2,5; 5; 2,5} = 2,5

Y_4^- = min {13,33333; 0; 3,333333; 0; 0; 3,333333; 6,666667; 0; 6,666667; 6,666667} = 0

Determining the Distance Between Each Weighted Alternative and the Positive Ideal Solution

$D_1^+ =$

$$\sqrt{(5{,}24760 - 5{,}368559)^2 + (4{,}651163 - 4{,}651163)^2 + (2{,}5 - 5)^2 + (13{,}33333 - 13{,}33333)^2}$$

$= 2{,}50292$

Determining the Distance Between Each Weighted Alternative and the Negative Ideal Solution

$D1- =$

$$\sqrt{(5{,}24760 - 4{,}665307)^2 + (4{,}651163 - 1{,}860465)^2 + (2{,}5 - 2{,}5)^2 + (13{,}33333 - 0)^2}$$

$= 13{,}63469$

Calculating the Preference Value for Each Alternative

$V1 = \frac{13{,}63469}{2{,}50292+13{,}63469} = 0{,}844901$

$V2 = \frac{0{,}245937}{13{,}8573+0{,}245937} = 0{,}0174383$

$V3 = \frac{3{,}47272}{10{,}48324+3{,}47272} = 0{,}248834$

$V4 = \frac{0{,}287982}{13{,}57203+0{,}287982} = 0{,}0207779$

$V5 = \frac{13{,}3356}{13{,}58125+13{,}3356} = 0{,}495437$

$V6 = \frac{4{,}35230}{10{,}31962+4{,}35230} = 0{,}296641$

$V7 = \frac{7{,}21110}{7{,}40432+7{,}21110} = 0{,}49339$

$V8 = \frac{2{,}81034}{13{,}5707+2{,}81034} = 0{,}171561$

$V9 = \frac{7{,}67964}{7{,}166666+7{,}67964} = 0{,}517276$

$V10 = \frac{7{,}22720}{7{,}62271+7{,}22720} = 0{,}486683$

Based on the calculations performed, the alternative with the code A1 represents the highest preference, with a preference value of 0.844901. The value of A1 is higher compared to other alternatives. Thus, the student selected as the scholarship recipient, according to the criteria, is A1, as it aligns most closely with the criteria established by the PMB (New Student Admission) office of Telkom Purwokerto University. The order of preference is as follows: A1, A9, A5, A7, A10, A6, A3, A8, A4, and A2.

E. Conclusion

Based on the objectives and purposes of this study, the conclusion drawn is that the use of the TOPSIS method for selecting FON scholarship recipients enables the identification of the

most suitable candidates through the calculated results. The decision support system's calculation is based on four predetermined criteria: the student's average grade, their position in the OSIS (student council), their organizational or experiential background, and their achievements. After determining the evaluation criteria, the preference weights for each criterion were established, taking into account the relative importance of each criterion compared to others. In this study, a sample of 10 students was used for the calculations. Observing the results above, the positive solution value is 0.844901, and the negative solution value is 0.0174383. Thus, it can be concluded that the use of the TOPSIS method successfully identified A1 as the scholarship recipient, as it aligns most closely with the PMB's criteria.

Bibliography

[1] W. Yusnaeni And N. Indriyani, "Sistem Pendukung Keputusan Pemilihan Siswa Yang Berhak Mendapatkan Beasiswa Dengan Metode Topsis," 2017. [Online]. Available: Http://Www.Bsi.Ac.Idhttp://Www.Bsi.Ac.Idhttp://Www.Bsi.Ac.Id

[2] B. Arifitama, "Jisa (Jurnal Informatika Dan Sains) Decision Support System Scholarship Selection Using Simple Additive Weighting (Saw) Method," *Jisa (Jurnal Informatika Dan Sains)*, Vol. 5, No. 1, Pp. 80–84, Jun. 2022.

[3] D. Wira Trise Putra, S. Noviasanti, G. Yoga Swara, And E. Yulianti, "Metode Topsis Dalam Sistem Pendukung Keputusan Pemilihan Objek Wisata," *Jurnal Teknoif Teknik Informatika Institut Teknologi Padang*, Vol. 8, No. 1, Pp. 1–6, 2020, Doi: 10.21063/Jtif.2020.V8.1.

[4] M. Awiet, W. Prasetyo, G. Setyaningsih, R. Bangkit Bachtiar, And D. Y. Saputri, "Tuan Desa Application Menggunakan Metode Topsis Sebagai Penentuan Rencana Kerja Pembangunan Desa," *Jurnal Sains Dan Teknologi*, Vol. 11, Pp. 38–46, 2022, Doi: 10.23887/Jst-Undiksha.V11i1.

[5] D. Alita, I. Sari, And A. Rahman Isnain, "Penerapan Naïve Bayes Classifier Untuk Pendukung Keputusan Penerima Beasiswa," *Jdmsi*, Vol. 2, No. 1, P. 702022, 2021.

[6] I. Ilham *Et Al.*, "Sistem Pendukung Keputusan Penerimaan Beasiswa Pada Smk 2 Sojol Menggunakan Metode Ahp," Vol. 4, 2018.

[7] A. ' Aro Laia, N. Telaumbanua, M. F. Nainggolan, P. Bimbingan, K. Stkip, And N. Selatan, "Mekanisme Dan Persyaratan Beasiswa Daerah," 2021.

[8] C. Sojow, V. Poekoel, And F. Kambey, "Sistem Pendukung Keputusan Pemilihan Jurusan Dengan Menggunakan Metode Simple Additive Weighting," *Jurnal Teknik Informatika*, Vol. 15, No. 2, Pp. 1–7, May 2020.

[9] D. Setiawan And R. Wicaksono, "Penerapan Sistem Pendukung Keputusan Pemilihan Karyawan Terbaik Di Cv. Mabertech," *Bulletin Of Applied Industrial Engineering Theory*, Vol. 2, No. 1, Pp. 49–54, 2021.

[10] I. G. Sudipa, Suyono, J. Pangaribuan, And A. Efri Trihandoyo, *Sistem Pendukung Keputusan*. Pt. Mifandi Mandiri Digital, 2023.

[11] W. Ramdhan, W. M. Kifti, W. Datur, And R. Sipahutar, "Penerapan Metode Topsis Pemilihan Role Model Pada Pengadilan Negeri Asahan," *Digital Transformation Technology (Digitech)*, Vol. 1, No. 1, Pp. 1–8, Jun. 2021, Doi: 10.47709/Briliance.Vxix.Xxxx.

[12] F. R. Darmawan, E. L. Amalia, And U. D. Rosiani, "Penerapan Metode Topsis Pada Sistem Pendukung Keputusan Untuk Kota Yang Menerapkan Pembatasan Sosial Berskala Besar Yang Di Sebabkan Wabah Corona," *Jurnal Sistem Dan Teknologi Informasi (Justin)*, Vol. 9, No. 2, P. 250, Apr. 2021, Doi: 10.26418/Justin.V9i2.43896.

[13] A. Azahari, P. Pahrudin, And Y. Yunita, "Penerapan Metode Topsis Pada Sistem Pendukung Keputusan Kelayakan Penerima Dana Bantuan Operasional Sekolah," *Building Of Informatics, Technology And Science (Bits)*, Vol. 4, No. 3, Dec. 2022, Doi: 10.47065/Bits.V4i3.2290.

[14] N. S. Ngaeni And K. Kusnawi, "Analisis Kombinasi Algoritma K-Means Clustering Dan Topsis Untuk Menentukan Pendekatan Strategi Marketing Berdasarkan Background Target Audiens," *Journal Of Computer System And Informatics (Josyc)*, Vol. 5, No. 2, Pp. 393–403, Feb. 2024, Doi: 10.47065/Josyc.V5i2.4948.

[15] D. R. Sari, A. P. Windarto, D. Hartama, And S. Solikhun, "Decision Support System For Thesis Graduation Recommendation Using Ahp-Topsis Method," *Jurnal Teknologi Dan Sistem Komputer*, Vol. 6, No. 1, Pp. 1–6, Jan. 2018, Doi: 10.14710/Jtsiskom.6.1.2018.1-6.