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ARAS METHOD FOR OPTIMIZING THE DETERMINATION OF PIP FUND RECIPIENTS

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Abstract: Program Indonesia Pintar (PIP) is government assistance program aimed at supporting the education of underprivileged students. However, some PIP fund recipients are misallocated, with aid given to students who do not fully meet the eligibility criteria, while those in greater need don't receive it, including at SDN 014672 Tanjung Alam, Asahan Regency, North Sumatra Province. Based on this issue, a structured system is needed. The purpose of this study is to construct decision support systems for determining PIP fund recipients using Additive Ratio Assessment (ARAS) method. Data was collected using questionnaires, documentation, and observation techniques. Respondents consisted of 8 students from SDN 014672 Tanjung Alam. Criteria include number of dependents, homeownership status, attendance rate, and students final grades. System was developed using CodeIgniter 3 as framework, MySQL as database software, and InnoDB as database engine. ARAS method was applied to rank available alternatives. Based on calculations, first rank was obtained by alternative 6 (Malika Hendra As-Syifa), second rank by alternative 7 (Mutia Indah Sari), and third rank by alternative 8 (Rafa Kavindra). This study is expected to be further developed by applying other DSS methods, performing regular system maintenance, and integrating system with school data to improve accuracy and usability.

Keywords: additive ratio assessment; decision support system; smart indonesia program.

Abstrak: Program Indonesia Pintar (PIP) merupakan bantuan pemerintah untuk mendukung pendidikan siswa kurang mampu. Namun, masih ditemukan penerima anggaran PIP yang kurang tepat sasaran, di mana bantuan diberikan kepada siswa yang kurang memenuhi kriteria, sementara siswa yang lebih membutuhkan tidak menerimanya, termasuk di SDN 014672 Tanjung Alam, Kabupaten Asahan, Provinsi Sumatera Utara. Berdasarkan permasalahan tersebut, dibutuhkan sebuah sistem terstruktur. Tujuan penelitian ini untuk membangun sistem pendukung keputusan penetapan pemeroleh anggaran PIP menggunakan metode Additive Ratio Assessment (ARAS). Data dikumpulkan dengan teknik angket, dokumentasi, dan observasi. Responden adalah 8 siswa SDN 014672 Tanjung Alam. Kriteria meliputi jumlah tanggungan orang tua, status kepemilikan rumah, tingkat kehadiran, dan nilai akhir siswa. Sistem dirancang menggunakan CodeIgniter 3 sebagai framework, MySQL sebagai database software, dan InnoDB sebagai database engine. Perhitungan dengan metode ARAS digunakan untuk merangking alternatif yang ada. Berdasarkan perhitungan yang dilakukan, peringkat pertama diperoleh oleh alternatif 6 yakni Malika Hendra As-Syifa, peringkat kedua diperoleh oleh alternatif 7 yakni Mutia Indah sari, dan peringkat ketiga diperoleh oleh alternatif 8 yakni Rafa Kavindra. Penelitian ini diharapkan dapat dikembangkan lebih lanjut dengan menerapkan metode Sistem Pendukung Keputusan (SPK) lainnya, melakukan pemeliharaan sistem secara berkala, serta mengintegrasikan sistem dengan data sekolah untuk meningkatkan keakuratan dan kemudahan penggunaan.

Kata kunci: additive ratio assessment; program indonesia pintar; sistem pendukung keputusan

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INTRODUCTION

Technology has become an inseparable part of human life and plays a significant role in various aspects, including education. One application of technology in education is the implementation of Decision Support Systems (DSS) to assist in making more accurate and objective decisions [1]. DSS can be applied in various aspects of education, one of which is the determination of recipients of the Program Indonesia Pintar (PIP), which aims to provide educational assistance to students from underprivileged families.

Program Indonesia Pintar (PIP) is President Jokowi's priority program to help children from underprivileged families to send their children to school for free from the ages of 6-21 years, so that they do not drop out of school [2]. However, in practice, the distribution of PIP funds still faces several challenges, such as inaccurate targeting, where funds are allocated to students who do not meet the eligibility criteria, while those ini greater need do not receive it. If this issues persists, it could threaten the educational continuity of students who genuinely need the PIP assistance.

Badan Pemeriksa Keuangan (BPK) recorded that out of IDR 2.86 trillion allocated to 5,364,986 students, some recipients did not meet the eligibility criteria, while 2,455,170 eligible students did not receive assistance [3]. A similar issue also occurs at SDN 014672 Tanjung Alam, an elementary school in Asahan Regency that receives PIP allocations. Data from the past three years indicate that 5% of PIP recipients do not fully meet the eligibility criteria, highlighting inaccuracies in the selection process.

Currently, PIP fund recipient selection in SDN 014672 Tanjung Alam is done manually, where homeroom teachers choose candidates based on subjective observation before reporting them to the school operator. This process is time-consuming and prone to human error, both in validation and data reporting. Therefore, a more objective and systematic approach is needed to ensure that PIP fund recipients are determined more accurately. An ARAS-based system has been developed to replace the manual method. This system automatically calculates and determines recipients based on measurable criteria, making the selection process faster, more objective, and structured, while reducing the risk of human error.

Previous research has applied Decision Support Systems (DSS) with various methods for PIP fund recipient selection. Syahputra et al. developed a web-based DSS using the ARAS method to determine BOS fund recipients, where only 2 out of 10 candidates were deemed eligible [4]. Syafira et al. combined AHP and ARAS for PKH recipient selection, demonstrating consistency between manual and system calculations [5]. Masni et al. compared SAW and MAUT methods in a web-based DSS for PIP scholarship selection, ensuring alignment between manual and system results [6]. Zualina et al. implemented ARAS in a web-based DSS for BNPT assistance, improving accuracy and efficiency in recipient determination [7]. Nanang et al. developed a web-based DSS using the TOPSIS method to determine PIP aid recipients, achieving a 7 out of 9 match with actual selections [8].

Determining PIP fund recipients using Decision Support Systems (DSS) with the Fuzzy AHP method also has been conducted [9]. However, this study using ARAS as a method for the selection process. The ARAS method provides a more structured ranking based

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on predefined criteria weights. Thus, this research contributes to optimizing the selection system for PIP fund recipients through the implementation of the ARAS method.

This study aims to analyze the process of determining PIP fund recipients at SDN 014672 Tanjung Alam and evaluate how the selection mechanism is conducted based on predefined criteria. The Additive Ratio Assessment (ARAS) method is applied as part of the Decision Support System to enhance accuracy and objectivity in determining recipients.

The ARAS method was chosen because it is considered capable of handling multi-criteria decision-making problems in a simple yet effective manner. The ARAS method also enables faster decision-making by utilizing a systematic calculations process and directly comparing alternatives with the ideal solutions [10].

METHOD

This study employs the Additive Ratio Assessment (ARAS) method to optimize the determination of PIP fund recipients at SDN 014672 Tanjung Alam. The ARAS method is used to assess the relative efficiency of various eligible alternatives by considering the values and weights of key criteria relevant to a given project. Through this approach, each alternative is evaluated based on predefined criteria.

The assessment compares each alternative against others, enabling the ranking of alternatives based on utility function values. This process aims to identify the most ideal alternative and provide the best outcome [11].

The following are the steps in the ARAS method [7]:

Formation of the Decision-Making Matrix

$$X = \begin{bmatrix} x_{0,1} & \cdots & x_{0,j} & \cdots & x_{0,n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i,1} & \cdots & x_{i,j} & \cdots & x_{i,n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m,1} & \cdots & x_{m,2} & \cdots & x_{m,n} \end{bmatrix} \quad (1)$$

Description:
m : number of alternatives
n : number of criteria
$X_{i,j}$: criteria value of alternative i
$X_{0,j}$: optimum value of criteria j

Normalization of the Decision Matrix

If the criteria is beneficial (max), normalization is performed as follows:

$$x^*_{i,j} = \frac{x_{i,j}}{\sum_1^m = 0 x_{i,j}} \quad (2)$$

If the criteria is non-beneficial, normalization is performed as follows:
Step 1:

$$x^*_{i,j} = \frac{1}{x^*_{i,j}} \quad (3)$$

Step 2:

$$R = \frac{x^*_{i,j}}{\sum_{i=0}^m x^*_{i,j}} \quad (4)$$

Determining the Weight of Matrix

$$D = [dij]\ m \times n = rij.wij \quad (5)$$

Description:
rij : normalization matrix
wij : weight of each criteria

Determining the Optimization Function Value

$$Si = \sum n = 1 dij (i = 1,2,.,m : j = 1,2,...,n) \quad (6)$$

Determining the Ranking

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$$K_i = \frac{Si}{So} \quad (7)$$

Where Si and So are the optimality criteria values.

This study optimizes PIP fund recipient selection using the ARAS method based on predetermined criteria. Parental income is the sole cost criterion, where lower values indicate greater financial need and higher priority. Benefit criteria include number of dependents, homeownership status, attendance rate, and final score where higher values are more favorable for selection.

Table 1. Criteria Table

Code	Criteria Name	Weight	Type
C1	Parental Income	0,3	Cost
C2	Number of Dependents	0,2	Benefit
C3	Homeowne rship Status	0,2	Benefit
C4	Attendance Rate	0,15	Benefit
C5	Final Score	0,15	Benefit

Each criteria has sub-criteria that are used to provide a more detailed assess-ment of each alternative.

Table 2. Sub Criteria for Parental Income

Criteria	Weight
< Rp. 1.000.000	4
Rp. 1.000.000 - Rp. 2.500.000	3
Rp. 2.500.000 - Rp. 5.000.000	2
> Rp. 5.000.000	1

Table 3. Sub Criteria for Homeownership Status

Kriteria	Weight
Rent/Lease	2
Own House	1

Table 3. Sub Criteria for Homeownership Status

Kriteria	Weight
Rent/Lease	2
Own House	1

RESULT AND DISCUSSION

The results of this study were obtained through a comprehensive analysis using the Additive Ratio Assessment (ARAS) method, which was implemented to determine the priority ranking of PIP fund recipients at SDN 014672 Tanjung Alam. The analysis began with selecting a dataset of potential PIP fund recipients, evaluated objectively based on predefined criteria. The data was then converted using assigned sub-criteria weights, forming a decision matrix as the basis for ARAS calculations.

Normalization followed, categorizing criteria as cost (lower values preferred) or benefit (higher values preferred). Next, weighting was applied, multiplying normalized values by criteria weights. The utility degree was then calculated to measure each candidate's priority. Finally, alternatives were ranked.

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Table 6. Data Sample

Alternatif	Parental Income	Number of Dependents	Home ownership Status	Attendance Rate	Final Score
Abinaya Alexi	Rp1.000.000	3	Own House	High	975
Alvin Dimas	Rp1.000.000	2	Own House	High	964
Tri Rismaharani	Rp1.000.000	3	Own House	High	997
Fakhira Talita Zahra	Rp1.000.000	2	Own House	High	1329
Muhammad Iqbal Ramadhan	Rp1.000.000	2	Own House	High	1364
Malika Hendra As-Syifa	Rp2.700.000	3	Own House	High	1494
Mutia Indah Sari	Rp2.700.000	3	Own House	High	1356
Rafa Kavindra	Rp3.000.000	3	Own House	High	1344

Table 7. Alternative Data Conversion

Alternatif	Criteria				
	C1	C2	C3	C4	C5
Abinaya Alexi	3	3	1	3	3
Alvin Dimas	3	2	1	3	3
Tri Rismaharani	3	3	1	3	3
Fakhira Talita Zahra	3	2	1	3	4
Muhammad Iqbal Ramadhan	3	2	1	3	4
Malika Hendra As-Syifa	2	3	1	3	4
Mutia Indah Sari	2	3	1	3	4
Rafa Kavindra	2	3	1	3	4

Table 8. Normalization

Alternatif	Criteria				
	C1	C2	C3	C4	C5
	0,0779	0,0732	0,1111	0,0625	0,0800
Abinaya Alexi	0,0519	0,0732	0,0556	0,0625	0,0600
Alvin Dimas	0,0519	0,0488	0,0556	0,0625	0,0600
Tri Rismaharani	0,0519	0,0732	0,0556	0,0625	0,0600
Fakhira Talita Zahra	0,0519	0,0488	0,0556	0,0625	0,0800
Muhammad Iqbal Ramadhan	0,0519	0,0488	0,0556	0,0625	0,0800
Malika Hendra As-Syifa	0,0779	0,0732	0,0556	0,0625	0,0800
Mutia Indah Sari	0,0779	0,0732	0,0556	0,0625	0,0800
Rafa Kavindra	0,0779	0,0732	0,0556	0,0625	0,0800

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Table 9. Weighted Normalization

Alternatif	Criteria				
	C1	C2	C3	C4	C5
	0,0234	0,0146	0,0222	0,0094	0,0120
Abinaya Alexi	0,0156	0,0146	0,0111	0,0094	0,0090
Alvin Dimas	0,0156	0,0098	0,0111	0,0094	0,0090
Tri Rismaharani	0,0156	0,0146	0,0111	0,0094	0,0090
Fakhira Talita Zahra	0,0156	0,0098	0,0111	0,0094	0,0120
Muhammad Iqbal Ramadhan	0,0156	0,0098	0,0111	0,0094	0,0120
Malika Hendra As-Syifa	0,0234	0,0146	0,0111	0,0094	0,0120
Mutia Indah Sari	0,0234	0,0146	0,0111	0,0094	0,0120
Rafa Kavindra	0,0234	0,0146	0,0111	0,0094	0,0120

Table 10. Optimum Value and Utility Degree

Alternatif	Optimum Value	Utility Degree
	0,0816	
Abinaya Alexi	0,0597	0,7316
Alvin Dimas	0,0548	0,6718
Tri Rismaharani	0,0597	0,7316
Fakhira Talita Zahra	0,0578	0,7086
Muhammad Iqbal Ramadhan	0,0578	0,7086
Malika Hendra As-Syifa	0,0705	0,8638
Mutia Indah Sari	0,0705	0,8638
Rafa Kavindra	0,0705	0,8638

Table 11. Ranking Result

Alternatif	Rank
Malika Hendra As-Syifa	1
Mutia Indah Sari	2
Rafa Kavindra	3
Abinaya Alexi	4
Tri Rismaharani	5
Fakhira Talita Zahra	6
Muhammad Iqbal Ramadhan	7
Alvin Dimas	8

Dashboard View

This section provides an overview of the system and serves as the main navigation. It displays various menu options, including criteria data, sub-criteria data, alternative data, assessment data, calculation data, final result data and user data, allowing users to access and manage different aspects of the system efficiently.

Image 1. Dashboard View

Criteria Data View

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This section presents the list of criteria data used in the decision-making process. Admin users have full control over managing the criteria, including adding, editing, or removing entries as needed to ensure accurate and up-to-date infor-mation

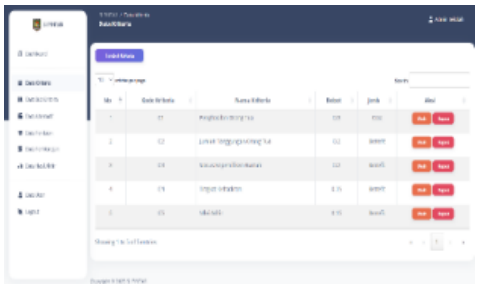

Image 2. Criteria Data View

Sub Criteria Data View

This section displays sub-criteria data associated with each main criteria. It provides a more detailed breakdown of the decision parameters, helping refine the assessment process. Admin users can manage the sub-criteria by modifying existing entries or adding new ones..

Image 3. Sub Criteria Data View

Result Data View

This section presents the final results of the evaluation process, where all alternatives are ranked based on the assessment criteria. The ranking allows for a clear comparison between alternatives, and the results can be exported or printed as a formal report for documentation or further review.

Image 5: Result Data View

Black Box Testing

Table 12. Testing of Calculation Data Page

Input Data	Expected Process	Observation	Conclusion
Enter alternative data and criteria values	The system calculates and displays the ranking	Ranking displayed correctly	Passed

Table 13. Testing of Final Result Data Page

Input Data	Expected Process	Observation	Conclusion
Click the print button	The system generates the final ranking report	Print button functions correctly	Passed

CONCLUSION

This research resulted in a decision support system for determining the recipients of the Indonesia Smart Program (PIP) fund at SDN 014672 Tanjung Alam. The system was developed using CodeIgniter 3 as the framework, MySQL as the database software, and InnoDB as the database engine. By implementing the ARAS method, the system processes data based on predefined criteria weights,

performs normalization, weighting, and optimization function calculations to determine recipient rankings objectively and accurately. The developed system runs properly as expected

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