DOI: 10.1442401/ijid.2023.4089 IJID (International Journal on Informatics for Development), *e-ISSN: 2549-7448*
Vol. 12, No. 1, 2023, Pp. 338-349

The WASPAS Method in Determining BSM Recipients Objectively

Tundo[1*], Panji Wijonarko[2]
Department of Informatics
Universitas 17 Agustus 1945 Jakarta
[1]tundo@uta45jakarta.ac.id,
[2]panji.wijonarko@uta45jakarta.ac.id

Muhammad Raffiudin[3]
Department of Computer Science
Chiang Mai University
[3]muhammad_r@cmu.ac.th

Article History
Received July 3rd, 2023
Revised November 13th, 2023
Accepted November 21st, 2023
Published November, 2023

***Abstract*—This research was conducted due to complaints from several parents regarding the determination of BSM at SDN Karanganyar 02 which still contains subjectivity in its selection so that some students are less fortunate. SDN Karanganyar 02, once a year always carries out activities related to determining the selection of BSM recipients. With this activity, it is hoped that students who are underprivileged but have fairly good achievements can receive this BSM so that the activities they carry out do not feel burdened with financial needs. The fact is that in institutions there are still many students who do not get BSM, even though according to the requirements these students should be eligible to get BSM. So in the selection that occurs there is a very irrational subjectivity. To solve this problem, the researcher tries to make a solution through an application that applies the Weight Aggregated Sum Product Assessment (WASPAS) method, which is a method of determining with predetermined criteria. The criteria in question are activities, achievements, report cards, parental income, home conditions, and parental dependents. After analyzing and implementing the WASPAS Decision Support System, it was found that the results were detrimental to students where the criteria scores and final determination were lower than some other students, but the SD carried out an assessment by obtaining BSM. To prevent this incident from recurring, WASPAS is very capable of answering objective determinations with the results obtained at 79.88% and the previous subjective determination at 20.12%.**

***Keywords*— *BSM; WASPAS; SDN Karanganyar 02; subjectivity; objectivity*.**

1 INTRODUCTION

BSM *(Bantuan Siswa Miskin)* is the assistance given to students from underprivileged families to be able to carry out learning activities at school [1]. This assistance provides opportunities for students to attend higher education levels. The purpose of providing BSM is to secure government programmes for completing the twelve-year compulsory education to eliminate the barriers for poor students to participate in school by helping poor students gain access to decent education services [2], prevent dropout rates, attract poor students to school, and help poor students meet their needs in learning activities.

Several similar studies related to the application of the WASPAS method as an ingredient in this study. First, research by Pagan and Syahrizal [3] whose object of scholarship recipients are outstanding students at the Office of Personnel and Human Resources Development (KKPSDM). In order to determine if the students in the office met the requirements for selection as scholarship beneficiaries based on factors such as GPA scores, families' income, dependents, and semesters, instances of A1, A2, A3, A4, and A5 were provided. From the results obtained, students with the initials A5 have the highest score, so A5 is a viable alternative to being chosen as a scholarship recipient. The shortcomings in this research do not explain the weighting process obtained, and the accuracy obtained is not visible in the research carried out. Second, according to Ihsan and Ginting [4], is the object of determining scholarship recipients at state universities. The available alternative data, namely, students at the Labuhan Batu Utara Regent's Office, in the study were given examples of A1, A2, A3, A4, A5, and A6 which, if appropriate, to be awarded a scholarship influenced by the criteria for test scores, proposals, achievements, transcript grades, and psychological tests. From the results, it was found that A5 students had the highest score, so A5 was a suitable alternative to receiving a scholarship at the office to enter State Universities. The shortcomings in this research do not explain the problems that occurred previously, and the large amount of data, and accuracy are also not visible in the research.

The three studies conducted by Lestari et al. [5] with the object of determining BSM at SMK Bina Mandiri used the Analytical Hierarchy Process (AHP) method. The alternative data used are all students at the school in 2019, of which 5 alternative examples were given in the study, symbolized as A1, A2, A3, A4, and A5. The criteria used to determine BSM beneficiaries are student status, parents' income, behavior, place of residence, and distance from home to school. After calculating using the AHP method, it is obtained that alternative A1 is a student who is eligible and appropriate to get a BSM scholarship. The weakness of this research is that it does not explain in detail how much data is used, and the accuracy that is formed after calculating it using the AHP method does not appear. The four studies conducted by Pratiwi et al [6] with research objects related to BSM at SMK N 2 Takalar were based on the Multi-Objective Optimization of the Basic Ratio Analysis (MOORA) method. The alternative data used are all students at the school in 2020, in which 8 alternative examples were given in the study, symbolized as A1, A2, A3, A4, A5, A6, A7, and A8. The criteria used in determining BSM are the Smart Indonesia Card, Family Hope Program, and Social Protection Card. After calculating and implementing it into the system using the MOORA method, it is found that alternative A6 is a student who is recommended to receive BSM based on the final results of this method. Denni [7] carried out five investigations using study objects connected to the BSM determination at SMP N 1 Lintongnihuta based on the Simple Additive Weighting (SAW) approach. The alternative data used are all students at the school in 2020, of which 7 alternative examples were given in the study, symbolized as A1, A2, A3, A4, A5, A6, and A7. The criteria used in determining the BSM are the average semester grades, the number of parents' dependents, parents' income, extra scores, and achievements. After calculating and implementing it into the system using the SAW method, it is found that alternative A4 is a student who is recommended to receive BSM based on the final results of this method which, are tested with manual and system calculations. The shortcomings in studies 4 and 5 do not explain in detail how much data is used, and the accuracy that is formed after being calculated using the chosen method is not visible, where study 4 uses MOORA and study 5 uses SAW.

In previous research which was used as a reference in this study, there are deficiencies where all the results obtained do not reveal the accuracy obtained, so it seems that it is only an implementation and application of a method used alone. In addition, the aims and objectives have not yet been clearly explained, only to design a system for determining BSM. Based on these deficiencies, the researcher emphasized this research, where apart from designing and building the system, the aims and objectives of this research were also explained based on the problems that occurred, namely to determine the level of subjectivity selected from the old system which was then compared with the new system using the WASPAS method at SDN Karanganyar 02.

SDN Karanganyar 02 is an educational institution that once a year carries out activities in determining BSM recipients. This activity is carried out to help students who are less well but have good enthusiasm and academic achievement. The fact that there are students who should be recommended but do not get BSM, makes it is very clear that it contains an element of subjectivity. In addition, evidence is included with complaints from parents of students who broke the results of BSM acceptance, which in terms of performance was very good financially and all requirements met the qualifications to receive BSM.

In solving the problems that have occurred above, an application is needed that can provide recommendations objectively so that students do not feel disadvantaged by the results obtained. The WASPAS method is one of the appropriate methods for solving the above case problems [8]-[9]. The reason for choosing the WASPAS method is because this method makes effective decision-making on complex problems, then simplifies it with a simple and fast mathematical process in the process of determining decision-making in solving problems to be solved [10][11]. In

addition, WASPAS is a combination of the combined Weighted Sum Model (WSM) and Weighted Product Model (WPM) [12][13].

2 METHOD

The method used in this study is based on the problems that have been discussed, namely, collecting student data by coming directly to the school so that the results of this research can solve the problems that have occurred, discussing with experts related to BSM at SDN Karanganyar 02 with the aim that these problems can be analyzed by experts and provide a definite reference in determining criteria and weight values and, implementing these problems using the WASPAS Decision Support System method. The first step is to carry out the data cleaning process that has been agreed upon between the expert and the school agency by describing the criteria, weights, and sets of each criterion along with the score of each of these sets [14][15]. The second step is to look for weighting values and normalization, and the final decision is ranking. The third step is implementing it into the system using the Java programming language, and the database is Mysql, and the last is comparing the results of the system with the previous system to know the accuracy of the percentage of subjectivity and objectivity that occurs. The following is an overview of the research methods carried out, shown in Figure 1.

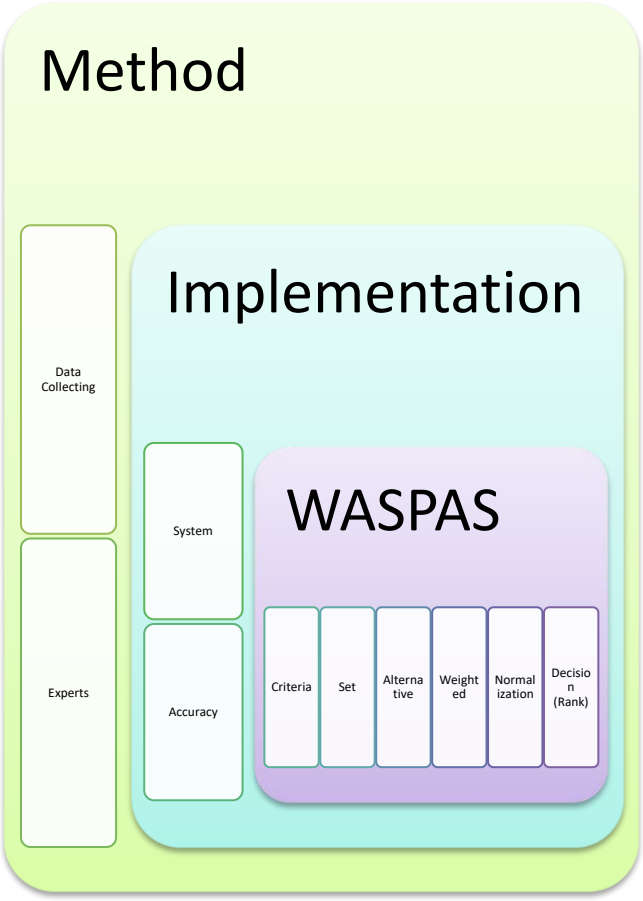

Figure 1. Research methods

2.1 *Data*

The data was obtained directly from one of the teachers at the school. The data was collected from 164 students in grades 1-6. Data was obtained on December 12, 2022. Overall, the data for each number of students per class can be seen in Table 1.

Table 1. Student Data

No	Class	Total Students
1	1 (One)	25
2	2 (Two)	35
3	3 (Three)	27
4	4 (Four)	27
5	5 (Five)	30
6	6 (Six)	20

2.2 *Experts*

Experts play a role in making decisions and assisting researchers in determining the characteristics of each criterion according to the object and determining the value of each criterion, as well as the set value of each criterion in determining the BSM concerning the problems in the institution, then results made by the expert are discussed with the school to be continued with the researcher, then researchers started to design and implement the WASPAS method for determining BSM [16][17]. It was agreed upon the results to be used in this study, namely activity criteria, achievement, average report cards, dependents, housing conditions, and parents' income.

2.3 *Implementation*

The Weight Aggregated Sum Product Assessment (WSPAS) method is a method for making effective decisions on complex problems by making easy mathematical simplifications and speeding up the decision-making process in solving the problems encountered [18][19]. The use of WASPAS method is a combination of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) [20]. The concept of this method uses linear normalization with the initial stages through the formed elements which are then carried out to improve the concept, namely WASPAS. The WASPAS method will look for the best match criteria based on 2 optimal criteria, namely the first optimization [21][22], then carry out the relevant weighted average success criteria from the WSM method. This method is a general strategy that is part of the Multi-Criteria Decision Making (MCDM) which evaluates several options against several existing criteria [23]. The following is an overview of the stages of implementing a system designed using the WASPAS method in determining BSM at SDN Karanganyar 02, as shown in Figure 2.

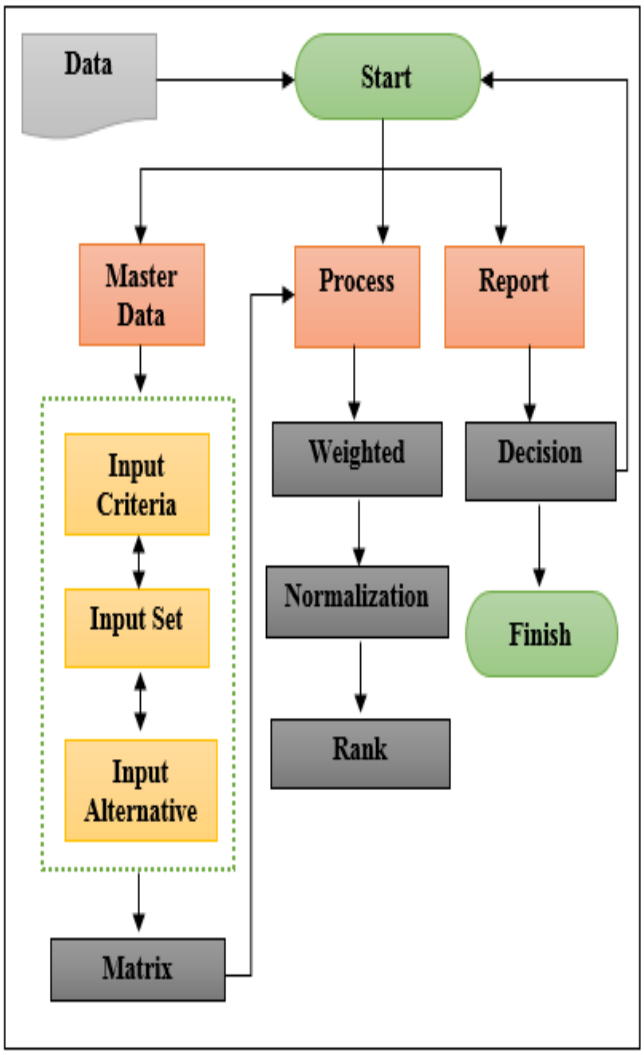

Figure 2. System flow

2.3.1 *Criteria:* Criteria are aspects used in determining BSM which can be seen in Table 2. Criteria are aspects used in this study, which consist of 6 criteria in determining BSM in schools as shown in Table 2.

Table 2. Criteria

Criteria Code	Criteria Name	Attribute	Weight
F1	Average report cards	Benefits	10
F2	Achievements	Benefits	15
F3	Activity	Benefits	15
F4	Parental income	Cost	20
F5	Dependents	Benefits	20
F6	Home Conditions	Cost	20

Determination in determining the weight value is determined based on a mutual agreement between the experts and the SD concerned with due regard to the criteria according to the research object that has been carried out. Because this research is related to BSM, the prioritized criteria are dependents, parents' income, and housing conditions, so the weight of these three criteria is greater than the other criteria, which have a total condition weight of 100 [24][25]. The benefits attribute is a profit attribute, where the greatest value is the best value [26], while the cost attribute is a cost attribute, where the smallest value is the best value [27].

2.3.2 *The set:* The set referred to here is the derivative aspect of each criterion, where each set has different derivatives with every other criterion due to having different interests and priorities in determining BSM, where the division of this set is produced based on a mutual agreement between the expert and the SD which is explained below.

The set of criteria for the average report card
The set of criteria on the average report card is divided into 4 parts: the first with a score of 5 is included in the 85-100 value category; a score of 4 is included in the 65-84 value category; a score of 3 is included in the 50-64 value category; score 2 is included in the value category less than 49 but not up to 0. All of this can be seen in Table 3.

Table 3. Set of Average Reports

Average report cards	Score
100 - 85	5
84 - 65	4
64 - 50	3
Less than 49	2

The set of achievement criteria
The set of achievement criteria is divided into 3 parts, which consist of *Many*, *Enough*, and *Less*.

Many: It says a lot on merit criteria when students get 3 international and 2 national or more than 4 awards internationally or 6 national, 3 province, and 3 districts or 1 international, 4 national, and 3 provinces.

Enough: It is said to be sufficient on the achievement criteria when students get 1 international, 4 national, and 2 province or 3 awards internationally or 2 international and 3 national or 3 national, 2 provinces, and 3 districts.

Less: It is said to be lacking in the achievement criteria when students get less from the set of many and enough. The data set of achievement criteria can

be seen in Table 4.

Table 4. Set of Achievements

Achievement	Score
Many	5
Enough	4
Less	3

The set of activeness criteria
The set of activeness criteria is divided into 2 parts, which consist of Active, and Enough.

Active: It is said to be active on the activeness criteria when students get a total score of 89 – 100.

Enough: It is said to be sufficient on the activity criteria when students get a total score of 73 – 88.
The data for the set of active criteria can be seen in Table 5.

Table 5. Set of Activities

Activity	Score
Active	5
Enough	3

The set of parental income criteria
The set of criteria for parents' salaries is divided into 5 sections, the first with a score of 5 is included in the salary category of more than 4 million, a score of 4 is included in the salary category of 3.1 million - 4 million, score of 3 is included in the salary category 2.1 million - 3 million, score of 2 is included in the salary category 1.2 million - 2 million, score of 1 is included in the salary category of less than 1.2 million but not up to 0 rupiahs. All of this can be seen in Table 6.

Table 6. Set of Parental Income

Parental Income	Score
> = Rp 4,100,000	5
Rp 3,100,000 – Rp 4,000,000	4
Rp 2,100,000 – Rp 3,000,000	3
Rp 1,201,000 – Rp 2,000,000	2
<= Rp 1,200,000	1

The set of dependent criteria
The set of criteria for dependents is divided into 4 parts, the first with a score of 5 included in the category of dependents more than 7, a score of 4 is included in the dependents category 4-6, a score of 3 is included in the dependents category 2-3, score 2 is included in the dependents category less than 1 but not up to 0. All of this is shown in Table 7.

Table 7. Set of Dependent

Dependent	Score
> = 7	5
4 – 6	4
2 -3	3
< =1	2

The set of house conditions
The set of house conditions is divided into 2 parts, which consist of *Eligible,* and *Less.*

Less: It is said to be inadequate according to the criteria for house conditions according to the Ministry of Health, namely, components and implementation in the spatial arrangement of the house far from ideal standards, building materials far from the standards of the Minister of Health, air quality far from healthy home standards, the size of house ventilation is far from ideal guidelines, natural lighting is not able to illuminate the entire room and the intensity is below 62 lux, there are disease-transmitting animals in the house, household waste cannot be managed properly due to lack of land, clean water resources are not met, there are no facilities for safe food storage and the bedroom is too crowded, only measuring 5x2 m.

Eligible: It is said to be eligible based on the criteria of housing conditions, meaning that it contains the opposite value to less worthy. The data set of house condition criteria can be seen in Table 8.

Table 8. Set of House Conditions

House Conditions	Score
Eligible	5
Less	1

2.3.3 *Alternative:* The alternative is student data used in the calculation process, alternative data contains NIS, Class, and Address. An alternative table can be seen in Table 9.

Table 9. Alternatives

NIS	Class	Address
2920	1 (One)	Cangkring 04/05, Karanganyar
2921	1 (One)	Kemuning 01/01, Bunton
2922	1 (One)	Pesapen 04/01, Karanganyar
2923	1 (One)	Bunton 01/08, Bunton
2924	1 (One)	Glempang 01/02, Karanganyar
2925	1 (One)	Kemuning 01/01, Bunton
2926	1(One)	Bunton 02/08, Bunton
2927	1(One)	Glempang 04/02, Karanganyar
2928	1(One)	Pesapen l 02/01, Karanganyar

NIS	Class	Address
2929	1(One)	Bengawan 01/02, Bunton
2930	1(One)	Sikengkeng 05/03,Karanganyar
2931	1(One)	G. Subroto 01/011, Adipala
2932	1(One)	Bunton 01/08, Bunton
2933	1(One)	Glempang 02/03, Karanganyar
2934	1(One)	Laut 05/02, Karanganyar
2935	1(One)	Pesapen 02/01, Karanganyar
2936	1(One)	Kemuning 02/01, Bunton
2937	1(One)	Laut 01/02, Karanganyar
2938	1(One)	Bunton 02/02, Bunton
2939	1(One)	Pesapen ll 03/02, Karanganyar
2940	2 (Two)	Pesapen 05/01, Karanganyar
2941	2 (Two)	Kemuning 01/01, Bunton
2942	2 (Two)	Glempang 01/02, Karanganyar
2943	2 (Two)	Bengawan 03/08, Bunton
2944	2 (Two)	Kemuning 01/01, Bunton
2945	2 (Two)	Penatusan 01/02, Bunton
2946	2 (Two)	Pesapen 05/01, Karanganyar
2947	2 (Two)	Glempang 02/02, Karanganyar
2948	2 (Two)	Glempang 03/02, Karanganyar
2949	2 (Two)	Pesapen 03/01, Karanganyar
2950	2 (Two)	Kemuning 01/01, Bunton
2951	2 (Two)	Pesapen l 03/01, Karanganyar
.....	.....	.....
.....	.....	.....
3058	6 (Six)	Sikengkeng 01/03, Karanganyar

2.3.4 *Weighting:* Weighting is the process of changing the initial data matrix where the data is not uniform, it is made of weighting data whose data values become uniform based on the scores in each set of criteria.

2.3.5 *Normalization:* Normalization is a process of combining each matrix element in an attribute so that each element in the matrix has a ratio value that is aligned with the specified value. The value of this ratio can be expressed as:

Benefit Criteria, the profit attribute, where the largest value is the best [28] as given in Equation 1.

$$X_{ij} = \frac{Xij}{Max\ Xij} \quad \text{.....(1)}$$

Cost Criteria, the cost attribute, where the smallest value is the best [29] as given in Equation 2.

$$X_{ij} = \frac{\text{Min } Xij}{Xij} \quad \text{..... (2)}$$

After the normalization process is carried out using Equations 1 and 2, the next step is to optimize the existing criteria in the WSM method. The WSM method is one of the methods that fall into the popular MCDM category for evaluating several alternatives that are interrelated with a set of decision criteria. Optimality criteria in the WSM method [30], namely the total importance of the criteria of the alternative, is calculated using Equation 3.

$$Qi_1 = \sum_{j=1}^{n} Xij\ Wj \quad \text{.....(3)}$$

On the other hand, according to the WPM method [31], the total importance of criteria from alternative *i* is calculated using the Equation 4.

$$Qi_2 = \prod_{j=1}^{n} (Xij)^{wj} \quad \text{.....(4)}$$

It is the WSM and WPM processes that result in the formation of the WASPAS method which is useful in finding the best alternative, which is shown in Equation 5.

2.3.6 *Ranking:* Ranking in this method, namely by making provisions for giving weights is that the value of the maximum specific gravity of the criteria is greater than the value of the minimum specific gravity of the criteria [32][33]. In indicating that an attribute is more important it can be multiplied by an appropriate weight [34]. The formula is the multiplication of the criteria weights to the maximum attribute values minus the multiplication of the criteria weights to the minimum attribute values if formulated then:

$$Qi = 0.5 \sum_{j=1}^{n} Xij\ Wj + 0.5 \prod_{j=1}^{n} (Xij)^{wj} \quad \text{.....(5)}$$

2.3.7 The results of the recommendation: The recommendation results from BSM recipients are the 3 best from each class. This decision is made by the school, where every year 3 students are eligible to receive BSM, the eligibility is purely based on the performance and achievements of the students concerned without any subjectivity.

2.4 Analysis of the comparison results

Analysis of comparative results is used to know the accuracy of the results of the old system and the new system

related to the subjectivity element that occurs in the old system. It thus proving that the old system needs to be updated so that no student is harmed [35][36], given in Equation 6.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} x\ 100\% \quad \text{.....(6)}$$

Where TP is True Positive, which means TP is calculated from the number of students who can be classified as accepted by BSM. TN is True Negative, which means TN is calculated from the number of students who cannot be classified as Haven't Gotten BSM. FP is False Positive, which means FP is calculated from the number of students who cannot be classified as accepted by BSM. FN is False Negative, which means that FN is calculated from the number of students who cannot be classified as Haven't Gotten BSM.

3 RESULT AND DISCUSSION

After all the alternative data have been collected and the methods used have been carried out, the next step is to calculate the calculation of the WASPAS method in determining BSM beneficiaries as follows:

3.1 WASPAS Calculation Proces

The formation of the matrix is formed from a combination of alternative data and criterion data, which results in the formation of the data in the form of initial data that holds the values of each alternative and criterion [37]-[38]. The initial data can be seen in Table 10.

Table 10. Initial Data

NIS	F1	F2	F3	F4	F5	F6
2920	80	Many	Active	Rp 1,000,000	5	Less
2921	85	Enough	Enough	Rp 2,000,000	4	Eligible
2922	90	Less	Enough	Rp 1,500,000	3	Eligible
2923	80	Enough	Active	Rp 2,500,000	4	Less
2924	85	Enough	Active	Rp 1,300,000	3	Eligible
2925	90	Many	Enough	Rp 900,000	2	Less
2926	75	Less	Active	Rp 1,100,000	3	Eligible
2927	80	Enough	Enough	Rp 4,200,000	4	Eligible
2928	80	Less	Enough	Rp 1,000,000	3	Eligible
2929	90	Less	Active	Rp 4,000,000	4	Eligible
2930	90	Less	Enough	Rp 900,000	4	Eligible
2931	85	Enough	Active	Rp 1,000,000	7	Eligible
2932	80	Many	Enough	Rp 2,500,500	4	Eligible
2933	85	Enough	Active	Rp 1,080,000	7	Eligible
2934	80	Many	Enough	Rp 2,500,100	4	Eligible
2935	80	Less	Enough	Rp 900,500	3	Eligible
2936	75	Less	Active	Rp 1,205,000	4	Eligible
2937	85	Enough	Active	Rp 1,300,600	4	Eligible
2938	90	Enough	Enough	Rp 2,000,010	3	Eligible
2939	90	Enough	Active	Rp 1,405,000	5	Eligible
2940	80	Less	Active	Rp 3,050,000	5	Eligible
2941	80	Many	Enough	Rp 900,000	4	Less
2942	85	Less	Enough	Rp 810,000	3	Less
2943	80	Many	Enough	Rp 1,050,000	4	Eligible
2944	80	Enough	Enough	Rp 1,500,800	4	Eligible
2945	90	Less	Active	Rp 900,000	3	Less
2946	90	Many	Active	Rp 1,201,000	3	Less
2947	75	Enough	Enough	Rp 950,900	3	Less
2948	75	Many	Enough	Rp 1,305,000	4	Eligible
2949	80	Many	Active	Rp 4,508,000	4	Eligible
2950	85	Enough	Active	Rp 1,000,600	7	Eligible
.....	.....	...	.....	.....	...	.....
.....	.....	....	.....	.....	...	.....
3058	80	Enough	Active	Rp 2,505,000	3	Eligible

The next step is to change the initial data into weighted data, where the weighted data is obtained from the score of each set on the criteria. The following is the weighting data in Table 11.

Table 11. Weighting Data

NIS	F1	F2	F3	F4	F5	F6
2920	4	5	5	1	4	1
2921	5	4	3	2	4	5
2922	5	3	3	2	3	5
2923	4	4	5	3	4	1
2924	5	4	5	2	3	5
2925	5	5	3	1	3	1
2926	4	3	5	1	3	5
2927	4	4	3	5	4	5
2928	4	3	3	1	3	5
2932	4	5	3	3	4	5
2933	5	4	5	1	5	5
2934	4	5	3	3	4	5
2935	4	3	3	1	3	5
2936	4	3	5	1	4	5
2937	5	4	5	2	4	5
2938	5	4	3	2	3	5
2939	5	4	5	2	4	5
2940	4	3	5	3	4	5
2941	4	5	3	1	4	1
2942	5	3	3	1	3	1
2943	4	5	3	1	4	5
2944	4	4	3	2	4	5

2945	5	3	5	1	3	1
.....	....	....	....	....	....	....
....	....	....	....	....	....	....
3058	4	4	5	3	3	5

Changing weighted data into normalized data is carried out using Equation 1 if the criterion is a benefit, or using Equation 2 if the criterion is cost. All the data above is normalized using Equations 1 and 2. This study provides an example of the process of calculating normalization on the criteria of average value (F1) for types of allowances and parental income (F4) for types of expenses.

Average report cards (F1):

$$A0001\ X_{11} = \frac{x_{11}}{Max\ Xij} = \frac{4}{5} = 0.8$$

$$A0002\ X_{21} = \frac{x_{21}}{Max\ Xij} = \frac{5}{5} = 1$$

$$A0003\ X_{31} = \frac{x_{31}}{Max\ Xij} = \frac{5}{5} = 1$$

$$A0004\ X_{41} = \frac{x_{31}}{Max\ Xij} = \frac{4}{5} = 0.8$$

$$A0005\ X_{51} = \frac{x_{31}}{Max\ Xij} = \frac{5}{5} = 1$$

Then the process is carried out until it stops at the last student data, namely NIS 3058.

Parental Income (F4):

$$A0001\ X_{14} = \frac{\text{Min Xij}}{\text{X14}} = \frac{1}{1} = 1$$

$$A0002\ X_{24} = \frac{\text{Min Xij}}{\text{X24}} = \frac{1}{2} = 0.5$$

$$A0003\ X_{34} = \frac{\text{Min Xij}}{\text{X34}} = \frac{1}{2} = 0.5$$

$$A0004\ X_{44} = \frac{\text{Min Xij}}{\text{X34}} = \frac{1}{3} = 0.33$$

$$A0005\ X_{54} = \frac{\text{Min Xij}}{\text{X34}} = \frac{1}{2} = 0.5$$

Then the process is carried out until it stops at the last student data, namely NIS 3058.

Overall, the normalization process of the above calculations is shown in Table 12.

Table 12. Normalization Data

NIS	F1	F2	F3	F4	F5	F6
2920	0.8	1	1	1	0.8	1
2921	1	0.8	0.6	0.5	0.8	0.2
2922	1	0.6	0.6	0.5	0.6	0.2
2923	0.8	0.8	1	0.3333	0.8	1
2924	1	0.8	1	0.5	0.6	0.2
2925	1	1	0.6	1	0.6	1
2926	0.8	0.6	1	1	0.6	0.2
2927	0.8	0.8	0.6	0.2	0.8	0.2
2928	0.8	0.6	0.6	1	0.6	0.2
2929	1	0.6	1	0.25	0.8	0.2
2930	1	0.6	0.6	1	0.8	0.2
2931	1	0.8	1	1	1	0.2
2932	0.8	1	1	1	0.8	1
2933	1	0.8	1	1	1	0.2
2934	0.8	1	0.6	0.333	0.8	0.2
2935	0.8	0.6	0.6	1	0.6	0.2
2936	0.8	0.6	1	1	0.8	0.2
2937	1	0.8	1	0.5	0.8	0.2
2938	1	0.8	0.6	0.5	0.6	0.2
2939	1	0.8	1	0.5	0.8	0.2
2940	0.8	0.6	1	0.333	0.8	0.2
2941	0.8	1	0.6	1	0.8	1
2942	1	0.6	0.6	1	0.6	1
2943	0.8	1	0.6	1	0.8	0.2
2944	0.8	0.8	0.6	0.5	0.8	0.2
2945	1	0.6	1	1	0.6	1
2933	1	0.8	1	1	1	0.2
2934	0.8	1	0.6	0.333	0.8	0.2
2935	0.8	0.6	0.6	1	0.6	0.2
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
3058	0.8	0.8	1	0.333	0.6	0.2

The process uses the weight that has been defined by the decision-maker, in this case, means the expert. The weight is as follows:

W= {10, 15, 15, 20, 20, 20}

The final result is done by ranking the students, using Equation 5. Through the calculation process, we obtain as follows:

A0001

$Qi = 0.5 \sum_{j=1}^{n} Xij\ Wj + 0.5 \prod_{j=1}^{n} (Xij)^{wj}$

Q1= 0.5 x ∑ (0.8 x 10) + (1 x 15) + (1 x 15) + (1 x 20) + (0.8 x 20) + (1 x 20) + 0.5 x Π (0.8^{10}) x (1^{15}) x (1^{15}) x (1^{20}) x (0.8^{20}) x (1^{20})

= 47 + 0.0006190 = 47.000619

A0002

Q2= 0.5 x ∑ (1 x 10) + (0.8 x 15) + (0.6 x 15) + (0.5 x 20) + (0.8 x 20) + (0.2 x 20) + 0.5 x Π (1^{10}) x (0.8^{15}) x (0.6^{15}) x (0.5^{20}) x (0.8^{20}) x (0.2^{20})

= 30.5 + 0.00000000 = 30.5

A0003

Q3= 0.5 x ∑ (1 x 10) + (0.6 x 15) + (0.6 x 15) + (0.5 x 20) + (0.6 x 20) + (0.2 x 20) + 0.5 x Π (1^{10}) x (0.6^{15}) x (0.6^{15}) x (0.5^{20}) x (0.6^{20}) x (0.2^{20})

= 27 + 0.00000000 = 27

Then the process is carried out until it stops at the last student data, namely NIS 3058.

So, from the calculation process above, it produces a ranking data process using 3 students for the quota for each class. The research results presented below are students who get BSM, which as a whole can be seen in Table 13.

Table 13. Recommendation BSM

NIS	Class	Result	Rank	Recommendation
2920	1 (One)	47.000619	1	Accepted by BSM
2939	1 (One)	44.00003	2	Accepted by BSM
2925	1 (One)	43	3	Accepted by BSM
2958	2 (Two)	47.501888	1	Accepted by BSM
2951	2 (Two)	46.500202	2	Accepted by BSM
2944	2 (Two)	46.000018	3	Accepted by BSM
2981	3 (Three)	47.000619	1	Accepted by BSM
2986	3 (Three)	47.000619	2	Accepted by BSM
2985	3 (Three)	45.000027	3	Accepted by BSM
3008	4 (Four)	49.053687	1	Accepted by BSM
3014	4 (Four)	45.500021	2	Accepted by BSM
3017	4 (Four)	45.00002	3	Accepted by BSM
3035	5 (Five)	44	1	Accepted by BSM
3039	5 (Five)	43.50001	2	Accepted by BSM
3032	5 (Five)	42	3	Accepted by BSM
3043	6 (Six)	46.500202	1	Accepted by BSM
3057	6 (Six)	45.00002	2	Accepted by BSM
3048	6 (Six)	42.5	3	Accepted by BSM

3.2 Comparative Result Analysis

The results of the data ranking are depicted in Table 13. Next process, a data test, will be carried out with the results of the old system from the elementary school. It is to prove that there are elements that are not objective in determining poor scholarship recipients at SDN Karanganyar 02. The results are shown in Table 14.

Table 14. Comparison Results

NIS	Class	WASPAS Result	SD Result
2920	1 (One)	Accepted by BSM	Accepted by BSM
2939	1 (One)	Accepted by BSM	Haven't Gotten BSM
2925	1 (One)	Accepted by BSM	Accepted by BSM
2935	1 (One)	Haven't Gotten BSM	Accepted by BSM
2958	2 (Two)	Accepted by BSM	Haven't Gotten BSM
2951	2 (Two)	Accepted by BSM	Haven't Gotten BSM
2944	2 (Two)	Accepted by BSM	Accepted by BSM
2955	2 (Two)	Haven't Gotten BSM	Accepted by BSM
2956	2 (Two)	Haven't Gotten BSM	Accepted by BSM
2981	3 (Three)	Accepted by BSM	Accepted by BSM
2986	3 (Three)	Accepted by BSM	Haven't Gotten BSM
2985	3 (Three)	Accepted by BSM	Accepted by BSM
2978	3 (Three)	Haven't Gotten BSM	Accepted by BSM
3008	4 (Four)	Accepted by BSM	Haven't Gotten BSM
3014	4 (Four)	Accepted by BSM	Haven't Gotten BSM
3007	4 (Four)	Haven't Gotten BSM	Accepted by BSM
3035	5 (Five)	Accepted by BSM	Accepted by BSM
3039	5 (Five)	Accepted by BSM	Accepted by BSM
3032	5 (Five)	Accepted by BSM	Haven't Gotten BSM
3043	6 (Six)	Accepted by BSM	Accepted by BSM

NIS	Class	WASPAS Result	SD Result
3057	6 (Six)	Accepted by BSM	Haven't Gotten BSM
3050	6 (Six)	Haven't Gotten BSM	Accepted by BSM
3049	6 (Six)	Haven't Gotten BSM	Accepted by BSM
.....	.....	.....	.....
.....	.....	.....	.....

Based on Table 14, it is found that the accuracy of the objectivity analysis for determining the SD BSM seen by the WASPAS method using the confusion matrix concept is shown in Table 15.

Table 15. The Accuracy of the Objectivity Results

Recommendation	Accepted by BSM	Haven't Gotten BSM	Amount
Accepted by BSM	14	16	30
Haven't Gotten BSM	17	117	134
Amount	31	133	164

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \times 100\%$$

$$= \frac{14 + 117}{14 + 117 + 17 + 16} \times 100\ \%$$

$$= 79.88\ \%$$

Based on the accuracy obtained between the old system and the new system using WASPAS, it was found that the subjectivity value of the previous system reached 20.12% with an objectivity of 79.88%. After calculating and testing the results of the previous system using the WASPAS method, it was discovered that it still contained an element of subjectivity of 20.12%. This was very detrimental to students who were supposed to get BSM but were forced not to get their rights because some students who got it were purely subjective choices. Due to these problems, the WASPAS Decision Support System method is one of the solutions to help select objectively and avoid making the wrong choice again, because the process is carried out coherently from the beginning until the decision is made. Apart from that, the process also uses a computerized system which makes it easier for admins to determine BSM recipients, flexible, practical, and faster. Based on these results the element of subjectivity is still quite large so this is very detrimental to students in the school as graphically shown in Figure 3.

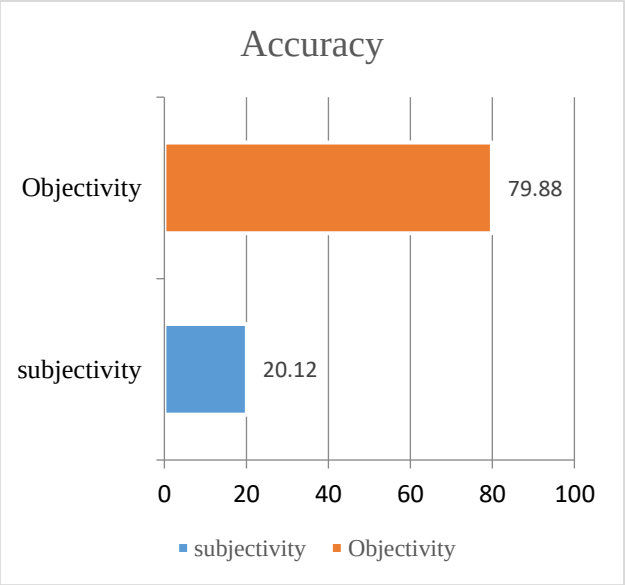

Figure 3. BSM recipient subjectivity tracking percentage

4 CONCLUSION

After implementing the calculations and building the system using the WASPAS method for determining BSM beneficiaries, the school understood the results of the recipients of BSM which are subjective. Accuracy results explain that 20.12% of BSM beneficiaries are subjective, and around 79.88% are objective. So some students are harmed by the element of subjectivity, even though it is not so significant, it has robbed the rights of students who should get BSM. It shows that the previous system tends to result subjective selection, which is detrimental to students who should have received but did not receive BSM. The further impact is demonstrated by the decline in academic grades and achievements of these students. Apart from that, parents of students are also affected by subjective selection where usually the expenditure on school needs is only related to the students' pocket money, but because their children were affected, expenses for school needs increased.

Based on the problems that occurred, and testing the previous BSM results using the WASPAS method, it was found that subjectivity was 20.12% so the old system still had injustice. In response to this, the WASPAS Decision Support System is very suitable for overcoming these problems, and the results obtained are worthy of students. Based on the weight of the criteria obtained by the students, it is then processed using WASPAS with a computerized system so that the results obtained cannot be manipulated again because the process is carried out sequentially from the beginning until a decision.

AUTHOR'S CONTRIBUTION

Tundo was the first author to conduct a literature review of previous studies, data collection, research ideas, analysis, and implementation, and Panji Wijonarko was the second author to provide suggestions and input on the research concept. Muhammad Raffiudin was the third author who reviewed the paper.

COMPETING INTERESTS

This section requires authors to declare that their work has no conflicts of interest (COI) or conflicts of interest (CI). A detailed explanation can be found in the journal's publication ethics.

ACKNOWLEDGMENT

The authors would like to thank all those who have contributed to the completion of this study, including family, friends, and faculty colleagues who shared their expertise and provided suggestions and encouragement.

REFERENCES

[1] Sinta M. Panjaitan, S. O. Manik, and A. Fau, "Sistem Pendukung Keputusan Dengan Menerapkan Metode WASPAS Untuk Menentukan Guru Bidang Kesiswaan," *Semin. Nas. Sains Teknol. Inf.*, pp. 614–619, 2019.

[2] R. Akbar and S. 'Uyun, "Penentuan Bantuan Siswa Miskin Menggunakan Fuzzy Tsukamoto Dengan Perbandingan Rule Pakar dan Decision Tree (Studi Kasus : SDN 37 Bengkulu Selatan)," *J. Teknol. Inf. dan Ilmu Komput.*, vol. 8, no. 4, p. 651, 2021.

[3] D. M. Pagan and M. Syahrizal, "Penerapan WASPAS Dalam Mendukung Keputusan Penerima Beasiswa Mahasiswa Berprestasi," *TIN Terap. Inform. ...*, vol. 1, no. 1, pp. 8–13, 2020.

[4] K. Ihsan and G. L. Ginting, "Penerapan Metode WASPAS Untuk Menentukan Penerima Beasiswa Pada Perguruan Tinggi Negeri," *TIN Terap. Inform. Nusant.*, vol. 1, no. 1, pp. 1–7, 2020.

[5] B. Lestari, N. Sri Rejeki, D. Gustian, and M. Muslih, "Penentuan Penerimaan Bantuan Siswa Miskin Menggunakan Analitycal Hierarchy Process," *J. Ris. Sist. Inf. dan Teknol. Inf.*, vol. 2, no. 3, pp. 32–44, 2020.

[6] N. A. D. Pratiwi, P. Purnawansyah, and H. Darwis, "Sistem Pendukung Keputusan Penerimaan Bantuan Siswa Miskin Menggunakan Metode Moora," *Bul. Sist. Inf. dan Teknol. Islam*, vol. 2, no. 3, pp. 131–139, 2021.

[7] Denni M Rajagukguk, "Rekomendasi Penerima Bantuan Siswa Miskin (BSM) dengan Metode Simple Additive Weighting (SAW). Studi Kasus : SMP N 1 Lintongnihuta," *JUKI J. Komput. dan Inform.*, vol. 1, no. 2, pp. 51–58, 2021.

[8] T. Tundo and D. Kurniawan, "Implementation of the Weighted Aggregated Sum Product Assessment Method in Determining the Best Rice for Serabi Cake Making," *IJID (International J. Informatics Dev.*, vol. 8, no. 1, p. 40, 2019.

[9] Z. Turskis, N. Goranin, A. Nurusheva, and S. Boranbayev, "A fuzzy WASPAS-based approach to determine critical information infrastructures of EU sustainable development," *Sustain.*, vol. 11, no. 2, 2019.

[10] D. Stanujkić and D. Karabašević, "An extension of the WASPAS method for decision-making problems with intuitionistic fuzzy numbers: a case of website evaluation," *Oper. Res. Eng. Sci. Theory Appl.*, vol. 1, no. 1, pp. 29–39, 2019.

[11] S. R. Andani *et al.*, "Application of the MOORA Method for Decision Making in Receiver Foundation Scholarship in AMIK Tunas Bangsa," *J. Phys. Conf. Ser.*, vol. 1255, no. 1, 2019.

[12] R. Bausys, G. Kazakeviciute-Januskeviciene, F. Cavallaro, and A. Usovaite, "Algorithm selection for edge detection in satellite images by neutrosophic WASPAS method," *Sustain.*, vol. 12, no. 2, 2020.

[13] A. R. Mishra and P. Rani, "Multi-criteria healthcare waste disposal location selection based on Fermatean fuzzy WASPAS method," *Complex Intell. Syst.*, vol. 7, no. 5, pp. 2469–2484, 2021.

[14] V. Simić, D. Lazarević, and M. Dobrodolac, "Picture fuzzy WASPAS method for selecting last-mile delivery mode: a case study of Belgrade," *Eur. Transp. Res. Rev.*, vol. 13, no. 1, 2021.

[15] G. S. de Assis, M. dos Santos, and M. P. Basilio, "Use of the WASPAS Method to Select Suitable Helicopters for Aerial Activity Carried Out by the Military Police of the State of Rio de Janeiro," *Axioms*, vol. 12, no. 1, 2023.

[16] T. Tundo and W. D. Nugroho, "An Alternative in Determining the Best Wood for Guitar Materials Using MOORA Method," *Int. J. Informatics Dev.*, vol. 9, no. 1, pp. 37–44, 2020.

[17] S. P. Singh, T. Kundu, A. Adhikari, and S. Basu, "An Integrated Weighting-based Modified WASPAS Methodology for Assessing Patient Satisfaction," *2020 Int. Conf. Decis. Aid Sci. Appl. DASA 2020*, pp. 592–596, 2020.

[18] M. Badalpur and E. Nurbakhsh, "An application of WASPAS method in risk qualitative analysis: a case study of a road construction project in Iran," *Int. J. Constr. Manag.*, vol. 21, no. 9, pp. 910–918, 2021.

[19] N. K. Daulay, B. Intan, and M. Irvai, "Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships," *Int. J. Informatics Comput. Sci.*, vol. 5, no. 1, pp. 84–94, 2021.

[20] J. Ali, Z. Bashir, and T. Rashid, "WASPAS-based decision making methodology with unknown weight information under uncertain evaluations," *Expert Syst. Appl.*, vol. 168, p. 114143, 2021.

[21] K. Rudnik, G. Bocewicz, A. Kucińska-Landwójtowicz, and I. D. Czabak-Górska, "Ordered fuzzy WASPAS method for selection of improvement projects," *Expert Syst. Appl.*, vol. 169, 2021.

[22] A. P. Sahida, B. Surarso, and R. Gernowo, "The combination of the MOORA method and the Copeland Score method as a Group Decision Support System (GDSS) Vendor Selection," *2019 2nd Int. Semin. Res. Inf. Technol. Intell. Syst. ISRITI 2019*, pp. 340–345, 2019.

[23] A. Baykasoğlu and İ. Gölcük, "Revisiting ranking accuracy within WASPAS method," *Kybernetes*, vol. 49, no. 3, pp. 885–895, 2020.

[24] S. V. B. Manurung, F. G. N. Larosa, I. M. S. Simamora, A. Gea, E. R. Simarmata, and A. Situmorang, "Decision Support System of Best Teacher Selection using Method MOORA and SAW," *2019 Int. Conf. Comput. Sci. Inf. Technol. ICoSNIKOM 2019*, 2019.

[25] D. Kalibatas and Z. Turskis, "Multicriteria Evaluation of Inner Climate by Using MOORA Method," *Inf. Technol. Control*, vol. 37, no. 1, pp. 79–83, 2016.

[26] A. Fedajev, D. Stanujkic, D. Karabašević, W. K. M. Brauers, and E. K. Zavadskas, "Assessment of progress towards 'Europe 2020' strategy targets by using the MULTIMOORA method and the Shannon Entropy Index," *J. Clean. Prod.*, vol. 244, 2020.

[27] A. N. Habibi, K. R. Sungkono, and R. Sarno, "Determination of Hospital Rank by Using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA)," *Proc. - 2019 Int. Semin. Appl. Technol. Inf. Commun. Ind. 4.0 Retrosp. Prospect. Challenges, iSemantic 2019*, no. 2, pp. 574–578, 2019.

[28] P. Rani, A. R. Mishra, and K. R. Pardasani, "A novel WASPAS approach for multi-criteria physician selection problem with intuitionistic fuzzy type-2 sets," *Soft Comput.*, vol. 24, no. 3, pp. 2355–2367, 2020.

[29] A. R. Mishra and P. Rani, "Interval-Valued Intuitionistic Fuzzy WASPAS Method: Application in Reservoir Flood Control Management Policy," *Gr. Decis. Negot.*, vol. 27, no. 6, pp. 1047–1078, 2018.

[30] A. Tuş and E. Aytaç Adalı, "The new combination with CRITIC and WASPAS methods for the time and attendance software

selection problem," *Opsearch*, vol. 56, no. 2, pp. 528–538, 2019.

[31] T. Tundo and D. Kurniawan, "Penerapan Metode Weighted Aggregated Sum Product Assesment dalam Menentukan Beras Terbaik untuk Pembuatan Kue Serabi," *J. Teknol. Inf. dan Ilmu Komput.*, vol. 7, no. 4, pp. 773–778, 2020.

[32] S. Manurung, I. M. S. Simamora, and H. Allagan, "Comparison of MOORA, WASPAS, and SAW Methods in Decision Support Systems," *J. Mantik*, vol. 5, no. 36, pp. 485–493, 2021.

[33] N. Handayani, N. Heriyani, F. Septian, and A. D. Alexander, "Multi-Criteria Decision Making Using the Waspas Method for Online English Course Selection," *J. Teknoinfo*, vol. 17, no. 1, p. 260, 2023.

[34] Tundo and W. D. Nugroho, "An Alternative in Determining the Best Wood for Guitar Materials Using MOORA Method," *IJID (International J. Informatics Dev.*, vol. 9, no. 1, pp. 37–44, 2020.

[35] T. Tundo and E. I. Sela, "Application of the Fuzzy Inference System Method to Predict the Number of Weaving Fabric Production," *Int. J. Informatics Dev.*, vol. 7, no. 1, pp. 1–9, 2018.

[36] A. Arisantoso, M. H. Somaida, M. Sanwasih, and M. I. Shalahudin, "Multi-Criteria Decision Making Using the WASPAS Method in Webcam Selection Decision Support Systems," *IJICS (International J. Informatics Comput. Sci.*, vol. 7, no. 1, p. 1, 2023.

[37] T. Tundo and D. Kurniawan, "Implementation of the Weighted Aggregated Sum Product Assessment Method in Determining the Best Rice for Serabi Cake Making," *Int. J. Informatics Dev.*, vol. 8, no. 1, pp. 40–46, 2019.

[38] F. Gurbuz and G. Erdinc, "Selecting the Best Hotel Using the Fuzzy-Moora Method with a New Combined Weight Approach," in *ISMSIT 2018 - 2nd International Symposium on Multidisciplinary Studies and Innovative Technologies, Proceedings*, 2018, pp. 1–8.