

Subjectivity Tracking System for Poor Scholarship Recipients at Elementary School Using the MOORA Method

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ABSTRACT

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This research was conducted because of complaints from several parents at Elementary School regarding recipients of the Poor Student Assistance (PSA) who were still less objective. Elementary School XY regularly conduct screening activities every year to select prospective PSA recipients. This selection is made so that the recipients of this assistance are students entitled to it. Some students should be accepted as a selection committee but do not mistake of choosing some students who have kinship or subjective matters. Therefore, this study aims to explore and create applications that apply the Multi Objective Optimization to the basic Ratio Analysis (MOORA) method, which is a method for determining students based on predetermined criteria. The criteria used are the value of report cards, student achievement, student activity, parental income, parental dependents, and home conditions. After conducting a search and implementation using the MOORA method in determining PSA recipients, it was found that there were some non-objective results where the student's criteria and final results were lower than some other students. However the Elementary School provided a recommendation to get PSA. If this happens again, then the importance of this system is to help objective selection. The accuracy results explained that 14.39% of PSA recipients were subjective. It was concluded that this research helps an objective decision and facilitates the decision maker in determining the best 3 recipients from each class at Elementary School XY.



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A. INTRODUCTION

PSA is an aid intended for underprivileged families so that their children can participate in learning activities at school without thinking about the existing costs (Akbar & 'Uyun, 2021). This assistance provides opportunities for students to attend higher education levels. The purpose of giving PSA is an activity from the government for students from underprivileged families to be able to follow the minimum compulsory education up to high school level equivalent (Assrani et al., 2018). Thus preventing the chain of dropping out of school and so that the students concerned can follow developments that occur so that there are no cases of fraud or specific individuals because all family members try to keep their children open to literacy, one of which is by participating in this government program.

A set of supporters in a similar study was taken as material. First, according (Akbar & 'Uyun, 2021) conducted research on social protection schools in one of Bengkulu using the Tsukamoto FIS method with the data criteria used were parents, protection cards, dependents, average report scores, achievements, and home ownership. This study resulted in an accuracy of 76% after being compared with the actual data. Second, according (Siregar et al., 2021) conducted research on determining the recipients of outstanding scholarships using the

Entropy TOPSIS method with the criteria used, namely knowledge value, skill value, achievement, organization, extracurricular, absenteeism, parental income, dependents, and scholarship status. This study provides recommendations in the form of ranking of merit scholarship recipients based on the value of each student's preference. Students who have high preference scores are prioritized as merit scholarship recipients. Although this system is successful in providing recommendations for students who receive merit scholarships, the final decision remains in the hands of the decision makers at the school. Third, according (Handayani et al., 2020) conducted research on the determination of scholarship selection at high schools in Jakarta with the method used was Profile Matching, which consisted of KKM criteria, presence, behaviour, discipline, and neatness. The results of the study are in the form of a scholarship selection system application that can be used as a decision-making tool while still being based on a decision support system using the Profile Matching Method. Based on the references mentioned, there are no studies that try to find solutions that arise from concerns from parents regarding the determination of PSA, but previous research has focused on making an application system that is useful to assist in making decisions. In addition, the criteria presented are different and this study also analyse the extent to which the element of subjectivity occurs in Elementary School XY.

Elementary School XY is a school institution that is routinely vulnerable every year to carry out activities to select the selection of PSA recipients. The selection process is carried out so that PSA recipients are less capable students. The fact is that there are students who should be able to but cannot because the selection committee has cheated by selecting several students who have kinship or the term is subjective. This information is evidenced by complaints from several guardians of students who question their children who do not receive PSA, even though all of the requirements meet the recipients' qualifications.

It is necessary to explore in-depth, and there is a need for a system that makes recommendations objectively so that things that are detrimental to students do not happen again. One appropriate method to implement the above case is to use the MOORA method (Sinaga et al., 2021). The reason for choosing this method is that it is simple, stable, and easy to understand, for people who are not from exact sciences can apply it (Manurung et al., 2021). In addition, MOORA has more accurate and targeted results in making decisions when compared to other methods (Brauers, 2018). This method is believed to be able to solve complex mathematical problems and has a level of flexibility and ease of understanding (Tundo & Kurniawan, 2019). This method can perform a good level of selectivity because it can recognize the purpose of the opposite criteria. The criteria consist of benefits and costs (Zaitun et al., 2019). The advantages of the MOORA method are that it is stronger, simpler, and relatively stable, and even this method does not require an expert in mathematics (Gurbuz & Erdinc, 2018). The purpose of this research is very clear, namely to help parents complain about their children to be treated fairly, especially in determining PSA so that the assessment is purely objective, there is no element of subjectivity, so that no party is harmed.

B. METHODS

The main methods used in this research include collecting data, discussing with experts related to BSM at Elementary School XY, implementing it, and comparing the results of the system made with the previous one. In detail, the research process is shown in Figure 1.

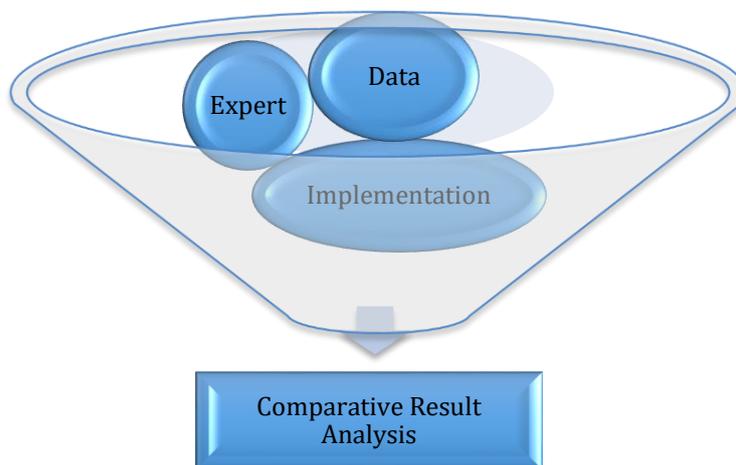


Figure 1. Research Flow

1. Data

The data was obtained from student data from grade 1 to grade 6 at Elementary School XY as many as 139 students. Data was obtained on October 10, 2020. In detail, student data is shown in Table 1.

Table 1. Student data

No	Class	Total students
1	1	20
2	2	30
3	3	24
4	4	24
5	5	24
6	6	17

2. Expert

Experts here play a role in determining the general criteria in determining PSA, as well as assisting in determining the set of each criterion and the weight of its value, by leading to agency problems with the results of discussions with the school, especially those in charge of PSA. It was agreed that the criteria used consisted of average report cards, achievements, activity, parental income, dependents, and home conditions.

3. Implementation

According to (Pane & Erwanyah, 2020), MOORA is a multi-objective system that maximizes two or more contradictory attributes and is processed simultaneously. The following are the stages of implementing the system built using the MOORA method in determining PSA at Elementary School XY.

a. Criteria

Criteria are aspects used in determining PSA which can be seen in Table 2.

Table 2. Criteria

Code	Criteria	Attribute	Weight
C1	Average report card	Benefit	10
C2	Achievement	Benefit	15
C3	Activeness	Benefit	15
C4	Parental income	Cost	20
C5	Dependent	Benefit	20
C6	House conditions	Cost	20

The determination in determining the weight value is carried out by mutual agreement between the expert and the Elementary School about the criteria according to the object of research, because this research is related to PSA, the priority criteria are the condition of the house, dependents, and parents' income so that the weight of the three criteria is greater than that another, where the sum of the total weight conditions is 100 (Trung et al., 2021).

b. The set

The set of question is a derivative aspect of each criterion used in determining PSA, in which the division in determining the set is determined by mutual agreement between the expert and the Elementary School which is explained as follows.

1) The set of criteria for the average report card

The set of criteria for the average report card is divided into 4 parts, where the data for the set of criteria for the average report card can be seen in Table 3.

Table 3. The set of criteria for the average report card

No	Average report card	Point
1	100 - 85	5
2	84 - 65	4
3	64 - 50	3
4	Less than 49	2

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 achievement criteria when students get more than 3 awards internationally or 2 international and 3 national or 1 international, 3 national, and 2 provincial or 5 national, 2 provinces, and 2 districts.

Enough: It is said to be sufficient on the achievement criteria when students get 2 awards internationally or 1 international and 2 national or 0 international, 3 national, and 1 province or 2 national, 1 province and 2 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. The set of achievement criteria

No	Achievement	Point
1	Many	5
2	Enough	4
3	Less	3

3) The set of activeness criteria

The set of activeness criteria is divided into 2 parts consisting Active and Enough.

Active: It is said to be active on the activeness criteria when students get a total score of 90-100.

Enough: It is said to be sufficient on the activeness criteria when students get a total score of 75 - 89. The data for the set of active criteria can be seen in Table 5.

Table 5. The set of activeness criteria

No	Activeness	Point
1	Active	5
2	Enough	3

4) The set of parental income criteria

The set of parental income criteria is divided into 5 parts, where the data on the set of parental income criteria can be seen in Table 6.

Table 6. The set of parental income criteria

No	Parental income	Point
1	$\geq 4.100.000$	5
2	3.100.000 - 4.000.000	4
3	2.100.000 - 3.000.000	3
4	1.201.000 - 2.000.000	2
5	$\leq 1.200.000$	1

5) The set of dependent criteria

The set of dependent criteria is divided into 4 parts, where the dependent criteria set data can be seen in Table 7.

Table 7. The set of dependent criteria

No	Dependent	Point
1	≥ 7	5
2	4 - 6	4
3	2 - 3	3
4	≤ 1	2

6) The set of house conditions

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

Less: It is said to be inadequate according to the criteria for housing conditions according to the Ministry of Health, namely, building materials far from the standards of the Ministry of Health, components and implementation in the spatial arrangement of the house are far from ideal standards, natural lighting is not able to illuminate the entire room and the intensity is below 60 lux, air quality is far from adequate. healthy house standards, the ventilation size of the house is far from ideal guidelines, there are disease-transmitting animals in the house, clean water resources are not met, there are no means for safe food storage, household waste cannot be managed properly due to lack of land, and the bedroom is too crowded, only measuring 4x2 m (Prasad & Sekar, 2016).

Feasible: It is said that it is feasible on the criteria for the condition of the house, which means that it contains a value that is opposite to less feasible. The data set of house condition criteria can be seen in Table 8.

Table 8. The set of house conditions

No	House conditions	Point
1	Feasible	5
2	Less	1

c. Alternative

The alternative is student data used in the calculation process, alternative data contains NIS, Class, Address, and Name of Parents. Alternative tables can be seen in Table 9.

Table 9. Alternative

NIS	Class	Address	Parents' name
2920	1	Jl. Cangkring 04/05, Karanganyar	Rui
2921	1	Jl. Kemuning 01/01, Bunton	Sao
2922	1	Jl. Pesapen 04/01, Karanganyar	Ngo
2923	1	Jl. Bunton 01/08, Bunton	Suo
2924	1	Jl. Glempang 01/02, Karanganyar	Sud
2925	1	Jl. Kemuning 01/01, Bunton	Wad
2926	1	Jl. Bunton 02/08, Bunton	Mar
2927	1	Jl. Glempang 04/02, Karanganyar	Riy
2928	1	Jl. Pesapen 1 02/01, Karanganyar	Sur
2929	1	Jl. Bengawan 01/02, Bunton	Abn
2930	1	Jl. Sikengkeng 05/03, Karanganyar	Slap
2931	1	Jl. G. Subroto 01/011, Adipala	Bud
2932	1	Jl. Bunton 01/08, Bunton	Was
.....
.....
3058	6	Jl. Sikengkeng 01/03, Karanganyar	Rat

d. Weighting

The weighting in this case is a process of student data obtained from the school, then converted into grades (Fedajev et al., 2020). The data that will be weighted is student data

from each criterion (Sugiyarto et al., 2021), where all the data will be converted into the form of values [1-5], based on the data set described above.

e. Normalization

Normalization has the aim of combining each element of the matrix so that the elements in the matrix have the same value (Gou et al., 2017). The normalization process can be expressed as:

$$X^*_{ij} = \frac{x_{ij}}{\sqrt{[\sum_{j=1}^m x_{ij}^2]}} \tag{1}$$

f. Ranking

Ranking in the MOORA method is conducted by an optimization process, using the equation (Hafezalkotob et al., 2019):

$$Y_i = \sum_{j=1}^g w_j X_{ij} - \sum_{j=g+1}^n w_j X_{ij} \tag{2}$$

g. Recommendation result

The results of the recommendation for BSM recipients are calculated using the MOORA method, which ranks third in the largest from each class, then the right student is selected to receive BSM.

4. Comparative Result Analysis

Analysis of the comparison results was carried out to find the accuracy of subjectivity and objectivity based on the results of the MOORA method which was then compared based on the results of Elementary School (Tundo & Sela, 2018).

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \times 100\% \tag{3}$$

C. RESULT AND DISCUSSION

1. MOORA Method Calculation

After all alternative data has been collected, the next step is the calculation of the MOORA method.

a. Matrix formation

The formation of a matrix between alternative data and criteria data, which produces initial data, can be seen in Table 10.

Table 10. Initial data

NIS	C1	C2	C3	C4	C5	C6
2920	80	Many	Active	Rp 1.000.000	5	Less
2921	85	Enough	Enough	Rp 2.000.000	4	Feasible
2922	90	Less	Enough	Rp 1.500.000	3	Feasible
2923	80	Enough	Active	Rp 2.500.000	4	Less
2924	85	Enough	Active	Rp 1.300.000	3	Feasible
2925	90	Many	Enough	Rp 900.000	2	Less

2926	75	Less	Active	Rp 1.100.000	3	Feasible
2927	80	Enough	Enough	Rp 4.200.000	4	Feasible
2928	80	Less	Enough	Rp 1.000.000	3	Feasible
2929	90	Less	Active	Rp 4.000.000	4	Feasible
2930	90	Less	Enough	Rp 900.000	4	Feasible
2931	85	Enough	Active	Rp 1.000.000	7	Feasible
2932	80	Many	Enough	Rp 2.500.000	4	Feasible
.....
.....
3058	80	Enough	Active	Rp 2.500.000	3	Feasible

b. Weighting process

The next step is weighting, based on the data set from each criterion (Siahaan et al., 2017). So that the weighting data obtained as shown in Table 11.

Table 11. Weight data

NIS	C1	C2	C3	C4	C5	C6
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
2929	5	3	5	4	4	5
2930	5	3	3	1	4	5
2931	5	4	5	1	5	5
2932	4	5	3	3	4	5
.....
.....
3058	4	4	5	3	3	5

c. Normalization process

The normalization process is carried out using the formula in equation (1) (Singh, 2017). All criteria are normalized, this study provides an example of the normalization calculation process on the criteria for the average value of report cards (C1) as follows:

$$C1 = \sqrt{4^2 + 5^2 + 5^2 + 4^2 + 5^2 + \dots + 4^2} = 53,84236$$

$$A0001 X_{11} = \frac{x_{11}}{53,84236} = \frac{4}{53,84236} = 0,07429$$

$$A0002 X_{21} = \frac{x_{21}}{53,84236} = \frac{5}{53,84236} = 0,09286$$

$$A0003 X_{31} = \frac{x_{31}}{53,84236} = \frac{5}{53,84236} = 0,09286$$

$$A0003 X_{41} = \frac{x_{31}}{53,84236} = \frac{4}{53,84236} = 0,07429$$

$$A0003 X_{51} = \frac{x_{31}}{53,84236} = \frac{5}{53,84236} = 0,09286$$

$$A0003 X_{61} = \frac{x_{31}}{53,84236} = \frac{5}{53,84236} = 0,09286$$

.....

.....

$$A0023 X_{231} = \frac{x_{151}}{53,84236} = \frac{4}{53,84236} = 0,07429$$

So from the calculation process above, it produces a data normalization process, which as a whole as shown in Table 12.

Table 12. Normalization data

NIS	C1	C2	C3	C4	C5	C6
2920	0,07429	0,10288	0,10099	0,03938	0,09054	0,02004
2921	0,09286	0,08230	0,06059	0,07875	0,09054	0,10018
2922	0,09286	0,06173	0,06059	0,07875	0,06790	0,10018
2923	0,07429	0,08230	0,10099	0,11813	0,09054	0,02003
2924	0,09286	0,08230	0,10099	0,07875	0,06790	0,10018
2925	0,09286	0,10288	0,06059	0,03938	0,06790	0,02004
2926	0,07429	0,06173	0,10099	0,03938	0,06790	0,10018
2927	0,07429	0,08230	0,06059	0,19688	0,09054	0,10018
2928	0,07429	0,06173	0,06059	0,03938	0,06790	0,10018
2929	0,09286	0,06173	0,10099	0,15749	0,09054	0,10018
2930	0,09286	0,06173	0,06059	0,03938	0,09054	0,10018
2931	0,09286	0,08230	0,10099	0,03938	0,11317	0,10018
2932	0,07429	0,10288	0,06059	0,11818	0,09054	0,10018
....
....
3058	0,07429	0,08230	0,10099	0,11813	0,06790	0,10018

d. Ranking process

The final result is done by ranking, using equation (2) (Deniz Basar & Guneren Genc, 2019). The calculation process is as follows.

A0001

$$Y1 = \sum (0,074291 \times 10) + (0,10288 \times 15) + (0,100995 \times 15) + (0,090536 \times 20) - \sum (0,039375 \times 20) + (0,020036 \times 20) = 5,611741 - 1,188221 = 4,423519$$

A0002

$$Y2 = \sum (0,092864 \times 10) + (0,082304 \times 15) + (0,060597 \times 15) + (0,090536 \times 20) - \sum (0,078356 \times 20) + (0,029841 \times 20) = 4,882861 - 3,578608 = 1,304253$$

A0003

$$Y3 = \sum (0,092864 \times 10) + (0,061728 \times 15) + (0,060597 \times 15) + (0,067902 \times 20) - \sum (0,078356 \times 20) + (0,029841 \times 20) = 4,121543 - 3,578608 = 0,542935$$

A0004

$$\begin{aligned}
 Y4 &= \Sigma (0,092864 \times 10) + (0,061728 \times 15) + (0,060597 \times 15) + (0,067902 \times 20) - \\
 &\Sigma (0,078356 \times 20) + (0,029841 \times 20) \\
 &= 4,121543 - 3,578608 = 0,542935 \\
 &\dots\text{etc.}
 \end{aligned}$$

Based on the above process, it produces 3 PSA recipients from each class as shown in Table 13.

Table 13. Ranking data

NIS	Class	Result	Rank	Decision
2920	1	4.42351968	1	Get PSA
2939	1	3.81755181	2	Get PSA
2925	1	3.55060044	3	Get PSA
2958	2	4.56755905	1	Get PSA
2951	2	4.30060768	2	Get PSA
2944	2	4.15656831	3	Get PSA
2981	3	4.42351968	1	Get PSA
2986	3	4.42351968	2	Get PSA
2985	3	3.99196832	3	Get PSA
3008	4	4.87619841	1	Get PSA
3014	4	4.11488032	2	Get PSA
3017	4	4.00327917	3	Get PSA
3035	5	3.81755181	1	Get PSA
3039	5	3.69463981	2	Get PSA
3032	5	3.36487308	3	Get PSA
3043	6	4.30060768	1	Get PSA
3057	6	4.00327917	2	Get PSA
3048	6	3.50891245	3	Get PSA
.....	Haven't got PSA yet
.....	Haven't got PSA yet

2. Comparative Result Analysis

The results of the ranking data (Table 13) will be tested with previous results from Elementary School, to prove that there are non-objective elements in Elementary School XY. The following comparison results can be seen in Table 14 and Table 15.

Table 14. Comparison results

NIS	Class	MOORA	Elementary School
2920	1	Get PSA	Get PSA
2939	1	Get PSA	Haven't got PSA yet
2925	1	Get PSA	Get PSA
2935	1	Haven't got PSA yet	Get PSA
2958	2	Get PSA	Haven't got PSA yet
2951	2	Get PSA	Haven't got PSA yet
2944	2	Get PSA	Get PSA
2955	2	Haven't got PSA yet	Get PSA
2956	2	Haven't got PSA yet	Get PSA

NIS	Class	MOORA	Elementary School
2981	3	Get PSA	Get PSA
2986	3	Get PSA	Haven't got PSA yet
2985	3	Get PSA	Get PSA
2978	3	Haven't got PSA yet	Get PSA
3008	4	Get PSA	Haven't got PSA yet
3014	4	Get PSA	Haven't got PSA yet
3017	4	Get PSA	Haven't got PSA yet
3009	4	Haven't got PSA yet	Get PSA
3007	4	Haven't got PSA yet	Get PSA
3035	5	Get PSA	Get PSA
3039	5	Get PSA	Get PSA
3032	5	Get PSA	Haven't got PSA yet
3028	5	Haven't got PSA yet	Get PSA
3043	6	Get PSA	Get PSA
3057	6	Get PSA	Haven't got PSA yet
3048	6	Get PSA	Haven't got PSA yet
3050	6	Haven't got PSA yet	Get PSA
3049	6	Haven't got PSA yet	Get PSA
.....
.....

Table 15. Elementary School Analysis Results compared to MOORA

	Get PSA	Haven't got PSA yet	Amount
Get PSA	9	10	19
Haven't got PSA yet	10	110	120
Amount	19	120	139

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \times 100\% = \frac{9+110}{9+110+10+10} \times 100\% = 85,61\%$$

This accuracy is the objective value obtained from the Elementary School system after being compared with the MOORA calculation, so it is found that the subjectivity accuracy value is 14.39%, which can be seen graphically as shown in Figure 2.

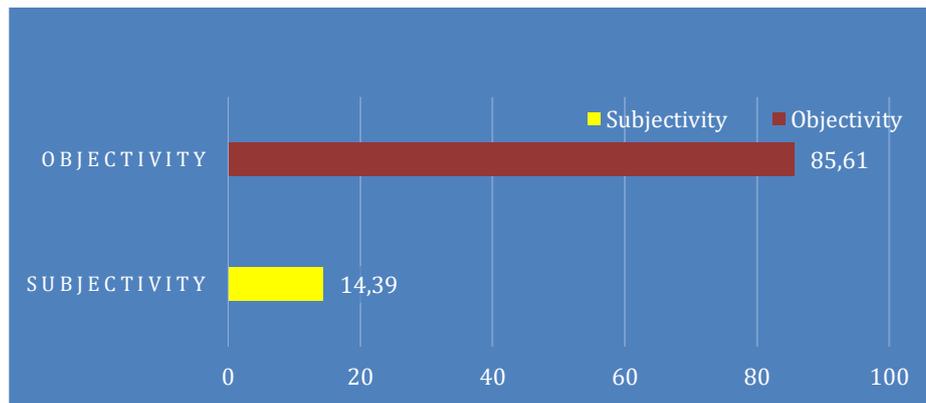


Figure 2. PSA Recipient Subjectivity Tracking Accuracy at Elementary School

Based on Figure 2, it was found that the subjectivity value that occurred at Elementary School XY was 14.39%, where this result was then analysed with the school, especially the PSA committee, they said that the accuracy produced was correct, because some students were accepted without any selection. This usually happens when the student has a family relationship with a high-ranking official at Elementary School XY.

D. CONCLUSION AND SUGGESTIONS

After testing and implementation using the MOORA method in determining PSA recipients, it was found that there were some non-objective results where the student's criteria and final results were lower than some of the other students. However, the Elementary School provided a recommendation to get PSA. To prevent this from happening again, the importance of this system is to assist in objective selection. The accuracy result explains that 14.39% of PSA recipients are subjective, and 85.61% are objective. So some students are disadvantaged by the element of subjectivity. Although it is not so significant, it has robbed the property of students who should receive PSA. Suggestions for further researchers can compare with other DSS methods to obtain knowledge of the extent to which other DSS methods determine PSA, as well as adding existing criteria so that the selection process is better and more objective.

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