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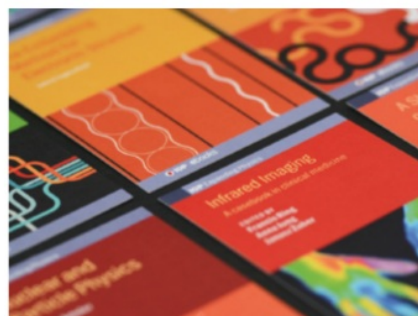
Decision Support System for Determining Scholarship Selection using an Analytical Hierarchy Process

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Abstract. Decision Support System is a computer program application that analyzes data and presents it so that users can make decision more easily. Determining Scholarship Selection study case in Senior High School in east Java wasn't easy. It needed application to solve the problem, to improve the accuracy of targets for prospective beneficiaries of poor students and to speed up the screening process. This research will build system uses the method of Analytical Hierarchy Process (AHP) is a method that solves a complex and unstructured problem into its group, organizes the groups into a hierarchical order, inputs numerical values instead of human perception in comparing relative and ultimately with a synthesis determined elements that have the highest priority. The accuracy system for this research is 90%.

1. Introduction

The 1945 Constitution of the Republic of Indonesia Chapter XIII about education article 31 point "Every citizen has the right to receive education and point 2 "Every citizen has the obligation to undertake basic education, and the government has the obligation to fund this" [1]. Based on data from Ministry Of Education and Culture Indonesia 2016/2017 east Java had the second rank for dropout school about 4157 student [2]. The high number of dropouts is due to the high cost of education [3].

Indonesian Cash Transfer Programme for Poor Student (BSM) or Scholarship is intended to remove barriers to participation in education and support at risk and poor students to gain access to educational services, prevent school drop-outs and help meet the educational needs of at-risk children. The BSM benefits are intended to cover associated educational costs, such as books, transportation to school and uniforms. The central government finances scholarship and does not require any contribution or cost-sharing from the beneficiaries of students or from local governments or schools (World Bank, 2012b). The combined intention of the two programs is to address both supply-side financial constraints and demand-side financial barriers to education [4].

BSM fund recipients administered by the Government of the Ministry of Education and Culture are poor students who have met the criteria as per the instructions or technical guidance issued by the Ministry of Education and Culture. The criteria for scholarship fund recipients are arrears of SPP payment, the amount of parent and parent dependents. Poor students are very old students who are less able to finance their children's education. Student support funds can be used by students for school purposes, school transportation costs and student pocket money. The disadvantage of this poor student assistance program is the accuracy of the targeted beneficiaries. Distribution of the poor grants program is still weak because it is found that many non-poor families who receive scholarship funds and students from poor families do not receive scholarship funds.

Schools in determining the ranking of beneficiaries of poor grants are still manual. In this case so that the process of ranking students who get scholarship funds more objective and effective, then made a decision support system. This system will help the school in conducting the selection of scholarship recipients of the student is still by way of income of parents from the largest to the smallest, parents dependents from the least to the most, the amount of less payment tuition from the least to the most and the time given short in doing Ranking so that the teachers difficult to determine the ranking. This system is expected to assist in the decision making process in increasing the accuracy of scholarship fund recipient target.

2. Literature Review

Literature review that will be used for this research are

2.1. Analytical Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP), introduced by Thomas Saaty (1980), is an effective tool for dealing with complex decision making, and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pair wise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process [5].

Table 1. Saaty Rating Scale for Pairwise Comparison Matrix [6]

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two factors contribute equally to the objective
3	Somewhat more importance	Experience and judgement slightly favour one over the other
5	Much more	Experience and judgement strongly favour one over the other
7	Very much more important	Experience and judgement very strongly favour one over the Other
9	Absolutely more important	The evidence favoring one over the other is of the highest possible validity
2,4,6,8	Intermediate value	When compromise is needed

The Advantage of AHP is that it illustrates how possible changes in priority in upper level have an effect on the priority of criteria at lower levels [7]. The following steps for applying the AHP are:

1. Define the problem and determine its goal.
2. Structure the hierarchy from the top (the objectives from a decision maker's viewpoint) through the intermediate levels (criteria on which subsequent levels depend) to the lowest level which usually contains the list of alternatives.
3. Construct a set of pair wise comparison matrices (size n x n) for each of the lower levels with one matrix for each element in the level immediately above by using the relative scale measurement shown in Table 1. The pair wise comparisons are done in terms of which element dominates the other.
4. There are n (n -1) /judgments required to develop the set of matrices in step 3. Reciprocals are automatically assigned in each pair-wise comparison.
5. Hierarchical synthesis is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy.
6. Having made all the pair-wise comparisons, the consistency is determined by using the Eigen value, λ max, to calculate the consistency index, CI as follows:

$$CI = \frac{(\lambda \max - n)}{n-1} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (1)$$

where n is the matrix size. Judgment consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value in Table 2. The CR is acceptable, if it does not exceed 0.10. If it is more, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.

7. Steps 3 - 6 are performed for all levels in the hierarchy.

Table 2. Average Random Consistency (RI)

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random Consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

3. Working Methodology

3.1. Identification problem

The help of poor students issued by the Government is still not appropriate in determining the students who receive poor student assistance. Distribution of poor student aid programs is still found in non-poor families and students from poor families do not receive BSM funds. A decision support system was created to help the problem. This system will assist teachers in reducing misconduct on poor grantees.

3.2. Criteria Analysis

The need to make this decision support system is data on the number of family dependents, data of less payment tuition fees and income data of parents. The criteria consists of the number of parental dependents, less payment tuition fees and parent's income. The number of dependents of this parent is the parents who still have dependents to finance their children for education or school. Unpaid Tuition payments are subject to requirements that students have arrears of Rp 3,000,000, - upwards and parents income of less than Rp 1,000,000.

3.3. Calculated Analytical Hierarchy Process (AHP)

3.3.1. Structure the hierarchy, the next level consists of criteria for assessing or considering alternatives. Each criterion can have an intensity value of each based on table 1.
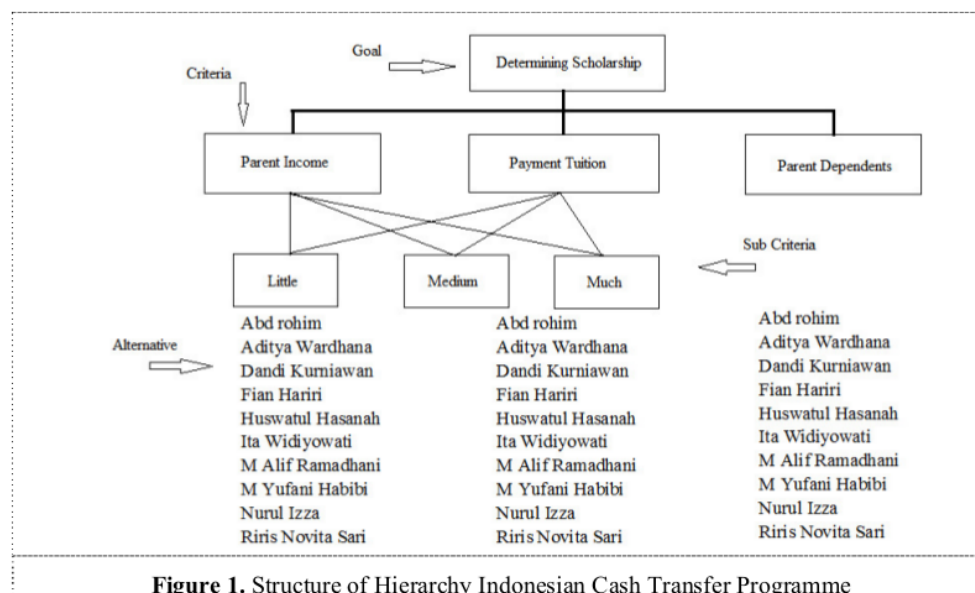

Figure 1. Structure of Hierarchy Indonesian Cash Transfer Programme

3.3.2. Pair-wise comparison matrix

Based on Table 1, it can be determine the pair wise comparison matrix as a table 3, where POT means parents income, TSPP means the less payment tuition and JTO means the number of dependents.

Table 3. Pair Wise Comparison Matrix

	POT	TSPP	JTO
POT	1	3	5
TSPP	0.33	1	3
JTO	0.2	0.33	1
SUM	1.53	4.33	9

3.3.3. Calculate the consistency index (C.I.)

Table 4. Synthesized matrix

	POT	TSPP	JTO	amount	Priority
POT	0.652	0.692	0.556	1.9	0.633
TSPP	0.217	0.231	0.333	0.781	0.260
JTO	0.13	0.077	0.111	0.318	0.106

Quantity: $2{,}579 + 1{,}050 + 0{,}426$ $= 4{,}055$
N (number of criteria) $= 3$
λ max: number / n $= 4{,}055 / 3 = 1{,}352$
CI ((λ max-n) / n) $= -0.549$
CR (CI / IR) $= -0.536 / 0.58 = -0.947$ (consistent)

From the calculation CR < 0.10 so it is consistent and do calculation for all criteria.

4. Experiment and Result

The result for decision support system using Analytical Hierarchy Process Method is implementation form methodology to software application Fig.2 shown about the calculation criteria
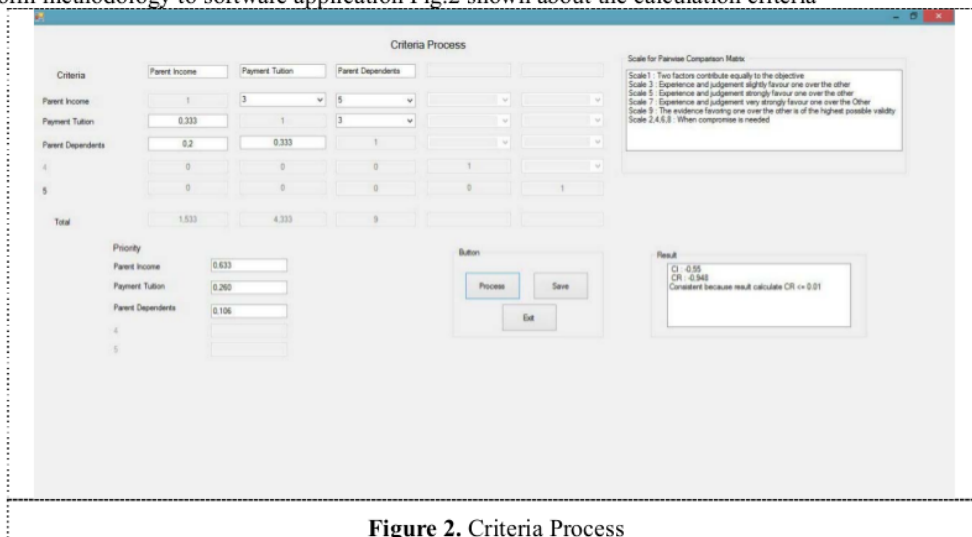

Figure 2. Criteria Process

The result of rank is used for the ranking process of scholarship candidates. The highest value of the results is eligible for a scholarship Fig 3. The process of testing by count manually in the object with the help of the school compared with the output of the software obtained accuracy of 90%
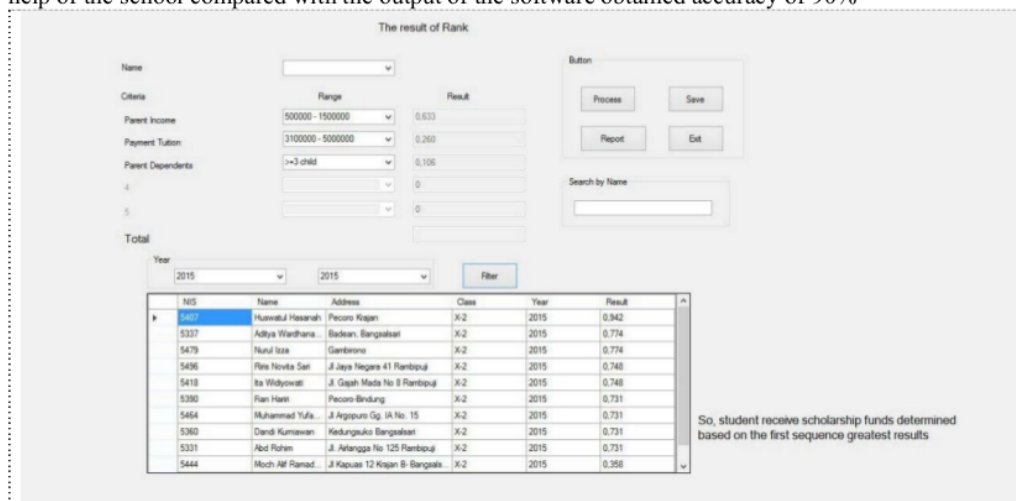

Figure 3. The Result of Rank

5. Conclusion

Based on decision support system with Analytical Hierarchy Process method for determination of scholarship can be concluded that:

1. This decision support system uses 3 criteria: parent income, less payment tuition and the number of parent dependents.
2. This decision support system can facilitate the selection process of prospective students who receive poor student's assistance.
3. Analytical Hierarchy Process method can be implemented in the calculation process of determining prospective recipients of Poor Student Assistance funds in each criterion or sub criteria to produce rank of each student.
4. The accuracy for this system is 90% comes from compare the system with the manual testing.

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