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The Study Program Selection System: Integrated Analytical Hierarchy Process (AHP) and Technique For Others Preference by Similarity to Ideal Solution (TOPSIS) Approach

Marni Erlina[1] and Okfalisa[2*]
Departement of Informatics Engineering, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia
erlinamarni@gmail.com[1], okfalisa@gmail.com[2*]

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ABSTRACT

The study program selection in several high schools or madrasah aliyah (MA) in Riau province is conducted manually. The initial survey found that the study program is commonly chosen by following the friend’s preference and parents’ option instead of their knowledge capability and desire. As a reflection, many students fail to adhere to the school subjects, obtain unsatisfactory results, and even change their study program. Therefore, this paper aims to assist students in altering the appropriate study program by considering students' capabilities, talents and interests by developing a multi-criteria decision support system (DSS). This DSS employs the integrated AHP approach for criteria weighting and TOPSIS for ranking alternatives. Herein, seventy students' data from grade ten MAN 2 Kuantan Singingi grows into this case study. The automation system analysis is executed through the web base DSS system using PHP programming language and MySQL database. As a result, AHP calculates the significance values of the criterion whereby the student interest score values at 0.34, academic report, potential academic test, physiological test, Pre-Test/Post-Test, interview scores, and teacher recommendation scores at 0.21, 0.14, 0.11, 0.09, 0.06, and 0.05, respectively. Subsequently, TOPSIS ranks the students according to the assessment and criteria weighting based on the standard requirement of study program in Mathematics and Science program (MIPA) and Social Science program (IIS). The DSS study program selection application has been tested using the Blackbox and User Acceptance Test (UAT) methods. Both of these approaches indicate that this application is functionally approved and capable of aiding the users in the optimal study program selection, with 81.9% agreement. In a nutshell, this DSS has successfully recommended the optimum study program per the students’ talents, interests, and capabilities and provided the direction development of students’ expertise area for the next level of education.

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Corresponding Author:

Okfalisa
Departement of Informatics Engineering
Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia
Email: okfalisa@gmail.com

1. INTRODUCTION

Due to improving the educational learning system, Indonesia has accomplished several changes efforts in the curriculum. Indonesia's educational curriculum 2013 is presented to perform the beneficial nation, creative, imaginative, and provide high values of integrity through the effectiveness of attitudes and skills [1]. The knowledge and educational background significantly impact the study program selection, especially during the higher school grade X level. The summary of the interview conducted with several high school students, teachers and parents (MAN 2) Kuantan Singingi found that students are commonly confused in making an appropriate choice for their study program selection. In addition, the deficient level of parental education fizzles out the reasonable suggestion that considering the student's aspect of assessment from personal abilities, interest, academic scores, and the study program prospects to meet further educational demand.

Meanwhile, the teachers put this selection under the parents' and students' responsibility. Thus, the students decide with no basic knowledge and follow their friends. In a nutshell, many students in high school fall through to keep their subject's performance satisfactory or even move into another subject. Ideally, the study program selection should be adjusted and directed according to the student's academic capabilities, interests and talents [2].

In order to solve the selection issues, multi-criteria decision-making grows into one of the common and effective decision support system (DSS) techniques used. The DSS is an analytical and information-collecting approach that administers the decision makers' solution in solving semi-structured and unstructured problems efficiently and effectively [3]. Various methods in decision support systems can be used by considering the advantages of each method as well as combined or integrated between methods. The AHP method has become a frequently used technique in decision-making that considers the analytical of pairwise comparisons in disclosure of the evaluation and weight factors within multi-factor conditions [4]. The AHP method aids in solving complex problems by structuring a hierarchy of criteria that correspond to interested parties to get the weight or priority of each criterion [5][6]. The user perspectives issues, diverse experience, expert knowledge base in determining criteria, and the influence of relationships between criteria can be overcome using this AHP concept [7]. Thus, the perfection of qualitative and quantitative assessment can be accommodated [8]. In addition, AHP has a fair measurement value for the consistency of evaluation procedures [9]. The calculation process of the AHP method is also rapid and widely possible to be integrated with various other techniques to obtain the optimum sensitive value in priority grouping, including the integration of AHP and TOPSIS.

The TOPSIS method has a simple concept and easy calculation. The TOPSIS analyzes the selected and optimum alternative by considering the shortest distance analysis of the positive ideal solution and the longest distance from the negative ideal solution [10]. The TOPSIS method provides a high value of ranking analysis as an advantage. This develops into the potential reasons for integrating TOPSIS with the AHP method [11]. Alazemi [12] has successfully evaluated the multi-criteria selection on the optimum energy sources crops. Herein, the AHP method is applied to assess the significant contributions of each criterion.

Meanwhile, the TOPSIS method is considered in ranking the recommended alternatives as the potential analysis. Bognár et al. [13] combined Multi-Criteria Decision Making (MCDM) and Geographic Information System (GIS) techniques in identifying the most appropriate location for wind farm installations. The AHP and GIS are used to analyze the most optimal location, and then the results of the location calculation are ranked using TOPSIS by considering the suitability of installation. Integrating these methods can easily overcome conflicting parameters and propose optimal solutions acceptable to the stakeholders in this study. Mukhoriyah et al. [14] carried out a similar integration between AHP through the process of inputting the regional data from GIS in forms of topographic features, soil characteristics, connectivity, settlements, natural resources and constraints, the availability of raw materials, the availability of labour, location of barren land, climate and around the main functional centre. After the industrial land suitability map is generated, the ranking analysis is carried out by applying the TOPSIS technique to determine the best preference based on the similarity and compatibility of alternatives with the ideal solution (TOPSIS). From the series of research reviews above, this study tries to apply the integration of AHP and TOPSIS in recommending the optimal study program for high school students in Riau province by considering the criteria including the interest score, academic report, potential academic test, physiological test, Pre-Test/Post-Test, interview scores, and teacher recommendation scores. Next, further ranking analysis using TOPSIS will be conducted based on the students and program requirements at MIPA and IIS programs. The recommendations are suggested by considering the student's capabilities, talents and interests as well as the school program achievement and targets that administer solutions and impacts for the students, parents and schools.

2. THE ORETICAL BACKGROUND

2.1. Analytical Hierarchy Process Method (AHP)

As previously described, MCDM AHP is a commonly utilized technique and continuously advanced to solve the various complex problems in weighting, expert assessments bias, linguistic problems in assessment interpretation, hierarchy effectiveness, and optimal sensitivity accomplishment. For instance, Kutlu and Kahraman [15] have successfully applied the original AHP into a spherical fuzzy AHP (SF-AHP) on the renewable energy sites selection; Zhang et al. [16] evolved a hybrid model based on AHP Fuzzy Rough-Sets in order to prompt the superlative evaluation methods in measuring the digital twin driven green performance; Lin et al. [17] put up a matrix consistency aggregation in AHP-group decision making (GDM) to improve the AHP performance.

In the educational field, the application of AHP was expanded by several researchers, including Han [18], who has employed AHP to evaluate the teachers quality in universities; Arora et al. [19] adopted Fuzzy AHP to prioritize the sustainability drivers based on the skills, competence, and work-based learning in the higher education system; Muhammad et al. [20] engaged Delphi and AHP in investigating factors affecting academic integrity in Saudi Arabian Universities e-Learning; Yuan and Li [21] exploited artificial neural network back propagation integrated with AHP in suggesting the college quality evaluation results; Fu et al. [22] integrated AHP and TOPSIS to identify the appropriate utilization of Information Technology (IT) approaches for music learning by considering the various features offered in existing IT applications. Dixit et al. [23] integrated AHP and TOPSIS to analyze the competency development for women's communities as edu-preneurs; Rahman et al. [24] implemented AHP-TOPSIS to figure out IT components in a dual education system (education and work need integration system) for the student job training.

In a nutshell, the advancement of AHP through the integration with other methods, including TOPSIS, increases the effectiveness of AHP in furnishing the appropriate and optimal recommendation system in decision-making. Firgiawan et al. [25] supported this argument by successfully conducting a comparative analysis between the SAW (Simple Adaptive Weighting), TOPSIS, SAW-AHP, and AHP-TOPSIS. Herein, the experimental results reveal that AHP-TOPSIS is the most accurate and sensitive approach for decision making, followed by the TOPSIS, SAW-AHP, and SAW for determining a single education fee assistance case. Therefore, integrating AHP-TOPSIS becomes a reasonable approach to solving the study program selection system. AHP will be utilized to assess the significance criteria by calculating the weights promoted by the experts or stakeholders, and TOPSIS for gauging the ranking and mapping of the student placement following the weight assessment values of criteria and study program requirements.

The following AHP stages are outlined below [6]:

1. Building a hierarchical structure based on decision-making objectives, criteria, and alternatives.
2. Finding the element's priority by paired matrix analysis and calculation
3. Conducting the Synthesis to obtain the matrix normalization and vector priority values. The consistency measurement is provided by calculating the $\lambda\ max$ value using the equation (1),

$$\lambda\ max = \frac{\sum\lambda}{n} \tag{1}$$

4. Calculating the values of the Consistency Index (CI) and Consistency Ratio (CR) with the rule that Consistency Ratio (CR) ≤ 0.1.

$$CI = \frac{(\lambda max - n)}{n-1} \quad (2)$$

$$CR = \frac{CI}{RI} \quad (3)$$

5. Whereby *n* is the number of elements, RI is the random consistency index, and *λ max is* defined as the sum of the quotients with the element present

2.2. Technique For Order Preferences By Similarity To Ideal Solution Method (TOPSIS)

The TOPSIS is determined by following the stages below [26][27] :

Figuring a criteria decision matrix (x)

$$x_{ij} = \begin{bmatrix} x_{11} & x_{12} & .x_{1j} \\ x_{21} & x_{22} & .x_{2j} \\ . & . & .. \\ x_{i1} x_{i2} & . & x_{ij} \end{bmatrix} \quad (4)$$

1. Whereby *xij* defines as elements of a weighted normalized decision matrix, *i* as the criteria on the *i-th* line, *j* as the criteria on the *j-th* line, and *w* as the weighted criteria.
2. We are normalizing the decision matrix (*rij*) using the equation below.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij^2}}} \quad (5)$$

3. Calculating the weighted normalized matrices *(yij)*

$$y_{ij} = w_j . r_{ij} \quad (6)$$

4. Determining the positive ideal solution (*A*+) and negative ideal solutions (*A*-) with the formula below.

$$A+ = (y_1+ , y_2+,\dots,y_j+,\dots,y_n+) \quad (7)$$
$$A- = (y_1- , y_2-,\dots,y_j-,\dots,y_n-) \quad (8)$$

5. Determining the distance of the positive ideal solution(s_i^+) dan negative ideal solution(s_i^-) with the following formula.

$$s_i^+ = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_j^+)^2} \quad (9)$$

$$s_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_j^-)^2} \quad (10)$$

6. Calculating the relative proximity (*Ci*+) as equation (11)

$$C_i^+ = \frac{s_i^-}{s_i^+ + s_i^-} \quad (11)$$

7. Calculating the order of preference

The final step is sorting the preferences from the highest relative proximity (C_i^+) into the lowest. As a result, the best alternative will be indicated by the optimum values of the relative proximity (C_i^+).

2.3. The Construction of Criteria for Study Program Selection

Criteria and sub-criteria are defined based on the interviews and document analysis of student interest and talent activity reports. The defined criteria are described in Table 1, which consists of the student interest (C1), academic report (C2), academic potential test scores (C3), psychological tests (C4), Pre-Test/Post-Test (C5), interviews (C6), and teacher recommendations (C7).

Table 1. Criteria and Sub-criteria for study program selection

No	Code	Criteria	Sub Criteria	Characteristic	Description
1	C1	Student Interests	-	Benefit	Student interest is defined as the student's inclination towards a particular subject in which he or she can easily connect without any hassle, hurdle, or even compulsion [27].
2	C2	Academic report	MIPA (SK1) IIS (SK2) Mathematics (SK3) English (SK4) Indonesian (SK5)	Benefit	Academic report is construed as the course lists and associated grades that have been attempted for high school college credit adjusted to the applicable curriculum [28].
3	C3	Academic Potential Test	-	Benefit	The Academic Potential Test (TPA) is a series of tests to determine students' talents, skills and abilities in the academic field [29].
4	C4	Psychological Tests	-	Benefit	Psychological tests area series of conducted tests to assess students from a psychological point of view in achieving their educational goals [30]. This physiological test is usually applied to determine the potential and opportunities of students to be placed in certain or desired schools.
5	C5	Pre-Test/Post-Test	-	Benefit	A pre-test is an initial test/exam to assess the student's general ability. Post-test is a test/exam to evaluate the student's ability after a certain treatment/program [31]. This is commonly oversight to monitor the extent of student learning process acceptance before and after treatment.
6	C6	Interview	-	Benefit	The interview is defined as one of the data or information-gathering procedures and activities that involve two or more parties, namely interviewers and respondents, for certain purposes [32].
7	C7	Teacher's Recommendation	-	Benefit	Teacher recommendation is designated as the teacher's suggestion to direct students'

		future education by considering the academic and non-academic portrait. It is commonly under the responsibility of an interest talent teacher. [33].

Meanwhile, the weight value on each criterion and study program preference is defined on a scale of 1 to 4. This weighting was obtained based on the school interviews. As a result, the interview mapping is specified in Tables 2 and 3.

Table 2. The Criteria and Sub-Criteria Weighted

No	Criteria	Description	Value	Weighting Scale
1.	Student interests		Excellent	4
			Good	3
			Good enough	2
			Not Good	1
2.	Academic report	92-100	Excellent	4
		83-91	Good	3
		75-82	Good enough	2
		0-74	Not Good	1
3.	Academic Potential Test	91-100	Excellent	4
		80-90	Good	3
		70-79	Good enough	2
		0-69	Not Good	1
4.	Psychological Tests		Excellent	4
			Good	3
			Good enough	2
			Not Good	1
5.	Pre-Test/Post-Test	86-100	Excellent	4
		76-85	Good	3
		60-75	Good enough	2
		0-60	Not Good	1
6.	Interview		Excellent	4
			Good	3
			Good enough	2
			Not Good	1
7.	Teacher's Recommendation		Excellent	4

Good	3
Good enough	2
Not Good	1

Table 3. The Preference Weighting of the Study Program

Criteria	Sub Criteria	Study Program	
		MIPA	IIS
Student interests	-	4	4
Academic report	MIPA	4	2
	IIS	2	4
	Mathematics	4	2
	English	3	3
	Indonesia	3	3
Academic Potential Test	-	3	3
Psychological Tests	-	3	3
Pre-Test/Post-Test	-	3	3
Interview	-	3	3
Teacher's Recommendation	-	3	3

3. RESEARCH METHODOLOGY

The stages of research methodology are carried out firstly by identifying several issues from thorough literature reviews, interviews and analysis of various related documents on the subject of study program selection at senior high school. The criteria and sub-criteria, as well as the weight values for criteria and scales, are also defined through document analysis, interviews and agreements from the head of the new student admissions committee, the curriculum section, and the counselling guidance teacher. Secondly, the analysis and calculation of the AHP approach are conducted by following the formula in Equations 1 to 3 to determine the significant values of each criterion and sub-criteria. Herein, the AHP questionnaire with a Saaty scale of 1 to 9 is distributed to ten respondents from the chair of the new student admissions committee, curriculum teacher, counselling teacher, and selected parents based on their level of education and competence. Next, the TOPSIS analysis (Equations 4 to 10) proceeds to rank and map based on the study program requirements. As a result, the optimal preference values are determined as the outstanding recommendation of the study program. The simulation of seventy students as alternatives are randomly utilized; thus, they are suggested to place into the MIPA or IIS program preferably. Finally, the automation of AHP and TOPSIS operational stages and calculations is employed by developing a web-based study program recommendation system. This application provides three main users: guidance and counselling teachers, the chairperson of the committee/administrator/IT operators, and the students. The study program recommendation system is tested using the Blackbox and the User Acceptance Test (UAT) techniques. Herein, eight respondents from the specifications as teachers, parents and students are asked for their agreement on the system's efficacy, ease of use, benefit, functionality, interface, and acceptability.

4. RESULTS AND ANALYSIS

4.1. AHP Calculation Analysis

Following the stages of AHP, the construction of a hierarchical structure for study program selection is described in Figure 1. Herein, the first layer determines the decision-making objective. The second layer performs the criteria and sub-criteria. The latest layer elucidates the seventy students as alternatives (A1-An).

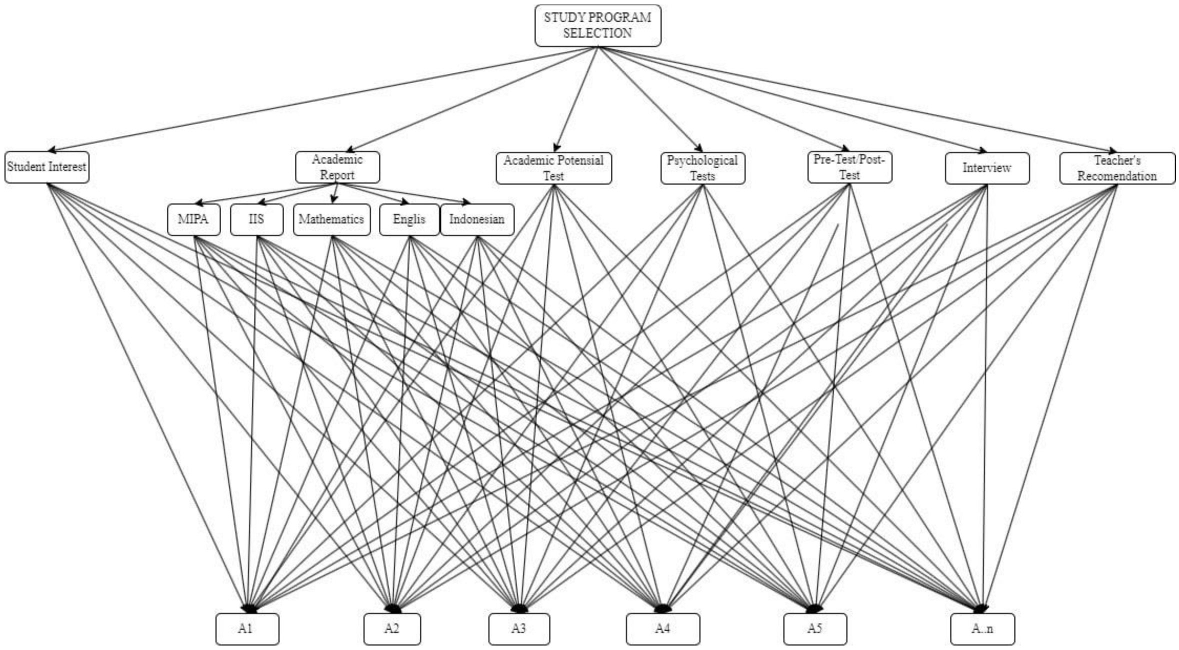

Figure 1. The Structure Hierarchy of Study Program Selection

Furthermore, the AHP analysis of the criteria and sub-criteria weighting built upon the calculation of Equations 1 to 3 are determined in Tables 4 to 6.

Table 4. The Criteria Paired Comparison Matrix

Criteria	C1	C2	C3	C4	C5	C6	C7
C1	1.00	2.45	2.45	3.87	3.87	5.29	5.29
C2	0.41	1.00	2.00	3.00	3.00	3.46	3.46
C3	0.41	0.50	1.00	2.45	2.45	2.00	2.00
C4	0.50	0.33	0.41	1.00	2.00	2.45	2.45
C5	0.33	0.33	0.41	0.50	1.00	2.00	2.45
C6	0.19	0.29	0.50	0.41	0.50	1.00	1.41
C7	0.19	0.29	0.50	0.41	0.41	0.71	1.00
Total	3.03	5.19	7.27	11.64	13.23	16.91	18.06

Table 4 explains the calculation of paired comparison values for each criterion. This analysis is obtained from the AHP questionnaire's dissemination to ten respondents. The comparison is conducted from criteria C1 against criteria C2, C3, C4, C5, C6, and C7. Then re-comparison is continually carried out from criterion C2 against criteria C1, C3, C4, C5, C6, and C7 for the entire pairs criteria.

Table 5. The Value Synthesis and Consistency

Criteria	C1	C2	C3	C4	C5	C6	C7	Sum	Vector Priority	λ (max)

C1	0.33	0.47	0.34	0.33	0.29	0.31	0.29	2.37	0.34	2.55
C2	0.13	0.19	0.28	0.26	0.23	0.20	0.19	1.48	0.21	1.61
C3	0.13	0.10	0.14	0.21	0.19	0.12	0.11	0.99	0.14	1.09
C4	0.17	0.06	0.06	0.09	0.15	0.14	0.14	0.80	0.11	0.85
C5	0.11	0.06	0.06	0.04	0.08	0.12	0.14	0.60	0.09	0.62
C6	0.06	0.06	0.07	0.04	0.04	0.06	0.08	0.40	0.06	0.41
C7	0.06	0.06	0.07	0.04	0.03	0.04	0.06	0.35	0.05	0.37
Total										7.49
λmax										1.07
Consistency Index (CI)										-0.99
Consistency Ratio (CR)										-0.75

Table 5 explains the vector priority values calculation viz. λmax, CI and CR values. The working out values for λmax are 1.07, CI at -0.99 and CR at -0.75. This indicates the acceptance criteria and sub-sub-criteria measurement variables for study program selection (CR <=0.10). Thus, the significance weighted of criteria and sub-criteria are defined in Tables 6 and 7.

Table 6. The Criteria Weighting

Code	Criteria	Weight
C1	Student interests	0.34
C2	Academic report	0.21
C3	Academic Potential Test	0.14
C4	Physiological Tests	0.11
C5	Pre-Test/Post-Test	0.09
C6	Interview	0.06
C7	Teacher's Recommendation	0.05

Table 7. The Sub Criteria Weighting for Student Interests

Code	Sub Criteria	Weight
SK1	MIPA	0.94
SK2	IIS	0.36
SK3	Mathematics	0.15
SK4	Indonesian	0.07
SK5	English	0.07

Table 6 interprets that students' interest (C1) grows into the most potential criteria with the weighted value at 0.34, followed by criteria C2, C3, C4, C5, C6, and C7, respectively. Meanwhile, Table 7 elucidates the priority significance of sub-criteria C1 into SK1, SK2, SK3, SK4, and SK5, respectively. The weighted value of criteria and sub-criteria play significant roles in placing and mapping the students in this study's program selection.

4.2. TOPSIS Calculation Analysis

Next, the final AHP weighting values are mapped into the assessment scores of 70 alternative students for subsequently calculating the TOPSIS analysis using Equations 4 to 10. As a result, Table 8 is defined as alternative initial data, and Table 9 is as alternative decision matrix calculation.

Table 8. The initial data of 70 alternative students

No	Alternative Code	C1	C2					C3	C4	C5	C6	C7
			SK1	SK2	SK3	SK4	SK5					
1	A1	MIPA	89	88	88	91	83	70	Good	65	Good	Good
2	A2	MIPA	84	89	90	92	91	67	Good	70	Good	Good
3	A3	MIPA	89	83	83	85	86	80	Good enough	72	Good enough	Good
4	A4	MIPA	84	81	79	84	81	72	Good	80	Good	Good
5	A5	MIPA	92	84	80	86	84	75	Not Good	55	Good	Good
...	...	...	...	...	...	...	...	...	...	...	...	...
66	A66	MIPA	86	82	80	87	82	64	Good	70	Good	Good
67	A67	MIPA	81	86	82	83	83	73	Excellent	83	Good	Good
68	A68	MIPA	85	79	75	85	77	56	Good	70	Good	Good
69	A69	IIS	80	76	79	82	80	68	Good	80	Good	Good
70	A70	MIPA	87	80	76	83	77	70	Good enough	75	Good	Good

Table 9. The decision matrix for alternative students

No	Alternative Code	C1	C2					C3	C4	C5	C6	C7
			SK1	SK2	SK3	SK4	SK5					
1	A1	3	3	3	3	3	3	2	3	2	3	3
2	A2	3	3	3	3	4	3	1	3	2	3	3
3	A3	3	3	3	3	3	3	3	2	2	2	3
4	A4	3	3	2	2	3	2	2	3	3	3	3
5	A5	3	4	3	2	3	3	2	1	1	3	3
...	...	...	...	...	...	...	...	...	...	...	...	...
67	A67	3	2	3	2	3	3	2	4	3	3	3
68	A68	4	3	2	2	3	2	1	3	2	3	3
69	A69	4	2	2	2	2	2	1	3	3	3	3
70	A70	3	3	2	2	3	2	2	2	2	3	3

The initial alternatives data is transformed into a decision matrix formatted with the scale values 1 to 4 for further normalisation, as determined in Table 10. Table 10 explains the matrix mapping analysis for each alternative into each criteria value. For instance, the alternative value of student A1 against C1 is 0.12, SK1, SK2, SK3, SK4, SK5 are 0.13, 0.14, 0.14, 0.13, 0.13, respectively, etc.

Table 10. Matrix Normalization

No	Alternative Code	C1	C2					C3	C4	C5	C6	C7
			SK1	SK2	SK3	SK4	SK5					
1	A1	0.12	0.13	0.14	0.14	0.13	0.13	0.13	0.13	0.09	0.12	0.13
2	A2	0.12	0.13	0.14	0.14	0.17	0.13	0.06	0.13	0.09	0.12	0.13
3	A3	0.12	0.13	0.14	0.14	0.13	0.13	0.19	0.09	0.09	0.08	0.13
4	A4	0.12	0.13	0.09	0.10	0.13	0.09	0.13	0.13	0.14	0.12	0.13
5	A5	0.12	0.17	0.14	0.10	0.13	0.13	0.13	0.04	0.05	0.12	0.13
...	...	...	...	...	...	...	...	...	...	...	...	...
66	A66	0.12	0.13	0.09	0.10	0.13	0.09	0.06	0.13	0.09	0.12	0.13
67	A67	0.12	0.08	0.14	0.10	0.13	0.13	0.13	0.17	0.14	0.12	0.13
68	A68	0.16	0.13	0.09	0.10	0.13	0.09	0.06	0.13	0.09	0.12	0.13
69	A69	0.16	0.08	0.09	0.10	0.08	0.09	0.06	0.13	0.14	0.12	0.13
70	A70	0.12	0.13	0.09	0.10	0.13	0.09	0.13	0.09	0.09	0.12	0.13

Likewise, the MIPA and IIS matrix normalization weight is defined in Tables 11 and 12.

Table 11. MIPA Normalized Matrix Weighted

No	Alternative Code	C1	C2					C3	C4	C5	C6	C7
			SK1	SK2	SK3	SK4	SK5					
1	A1	0.47	0.50	0.28	0.57	0.38	0.40	0.39	0.39	0.28	0.37	0.38
2	A2	0.47	0.50	0.28	0.57	0.50	0.40	0.19	0.39	0.28	0.37	0.38
3	A3	0.47	0.50	0.28	0.57	0.38	0.40	0.58	0.26	0.28	0.25	0.38
4	A4	0.47	0.50	0.19	0.38	0.38	0.27	0.39	0.39	0.42	0.37	0.38
5	A5	0.47	0.67	0.28	0.38	0.38	0.40	0.39	0.13	0.14	0.37	0.38
...	...	...	...	...	...	...	...	...	...	...	...	...
66	A66	0.47	0.50	0.19	0.38	0.38	0.27	0.19	0.39	0.28	0.37	0.38
67	A67	0.47	0.34	0.28	0.38	0.38	0.40	0.39	0.52	0.42	0.37	0.38
68	A68	0.62	0.50	0.19	0.38	0.38	0.27	0.19	0.39	0.28	0.37	0.38
69	A69	0.62	0.34	0.19	0.38	0.25	0.27	0.19	0.39	0.42	0.37	0.38
70	A70	0.47	0.50	0.19	0.38	0.38	0.27	0.39	0.26	0.28	0.37	0.38

Table 12. IIS Normalized Matrix Weighted

No	Alternative Code	C1	C2					C3	C4	C5	C6	C7
			SK1	SK2	SK3	SK4	SK5					
1	A1	0.47	0.25	0.56	0.29	0.38	0.40	0.39	0.39	0.28	0.37	0.38
2	A2	0.47	0.25	0.56	0.29	0.50	0.40	0.19	0.39	0.28	0.37	0.38
3	A3	0.47	0.25	0.56	0.29	0.38	0.40	0.58	0.26	0.28	0.25	0.38
4	A4	0.47	0.25	0.38	0.19	0.38	0.27	0.39	0.39	0.42	0.37	0.38
5	A5	0.47	0.34	0.56	0.19	0.38	0.40	0.39	0.13	0.14	0.37	0.38
...	...	...	...	...	...	...	...	...	...	...	...	...
66	A66	0.47	0.25	0.38	0.19	0.38	0.27	0.19	0.39	0.28	0.37	0.38
67	A67	0.47	0.17	0.56	0.19	0.38	0.40	0.39	0.52	0.42	0.37	0.38
68	A68	0.62	0.25	0.38	0.19	0.38	0.27	0.19	0.39	0.28	0.37	0.38
69	A69	0.62	0.17	0.38	0.19	0.25	0.27	0.19	0.39	0.42	0.37	0.38
70	A70	0.47	0.25	0.38	0.19	0.38	0.27	0.39	0.26	0.28	0.37	0.38

Finally, Tables 13 and 14 are actuated by following the equation formula 7 to 11 for resolving the positive and negative ideal solution values for MIPA and IIS and the preference values for each alternative student. Table 13 shows that the highest order of preference is C_{A1}^{+} MIPA with a value of 0.9115 and C_{A1}^{+} IIS with a value of 0.89230, and the lowest value is 0.0828 and 0.09770 for MIPA and IIS. Table 14 informs that student A1 is estimated placement into program MIPA with a preference value of 0.6786 and for IIS at 0.6181. Thus, the system suggests that student A1 select the MIPA program as the optimal study program option. A similar calculation is carried out for 70 alternative students.

Table 13. MIPA and IIS Preference Order

No	Students for MIPA	C^{+}	Students for IIS	C^{+}
1	A60	0.9115	A60	0.89230
2	A30	0.8908	A33	0.84440
3	A33	0.8719	A51	0.83423
4	A51	0.8614	A32	0.82160
5	A32	0.8533	A30	0.80265
...	...	...	...	...
66	A66	0.3867	A15	0.31274
67	A15	0.3556	A58	0.30236
68	A12	0.3541	A12	0.27278
69	A25	0.2993	A25	0.21572
70	A17	0.0828	A17	0.09770

Table 14. The Preferences values of Study Program Selection

No	Alternative	Program	Preferences MIPA	Preferences IIS	System Recommendations
1	A1	MIPA	0.6786	0.6181	MIPA
2	A2	MIPA	0.6371	0.5781	MIPA
3	A3	MIPA	0.6488	0.5880	MIPA
4	A4	MIPA	0.6417	0.5650	MIPA
5	A5	MIPA	0.5387	0.4593	MIPA
...	...	...	...	...	...
66	A66	MIPA	0.5136	0.4357	MIPA
67	A67	MIPA	0.6363	0.6828	IIS
68	A68	MIPA	0.6510	0.5801	MIPA
69	A69	IIS	0.5866	0.5714	MIPA
70	A70	MIPA	0.5379	0.4555	MIPA

For generating calculations, a Decision support system-based automation system is developed. The system architecture design is depicted in Figure 2. Meanwhile, one of the system interfaces for the TOPSIS analysis and calculation page can be seen in Figure 3. This DSS Study, Program selection system provides AHP and TOPSIS analysis to recommend the optimal study program for senior high school students.

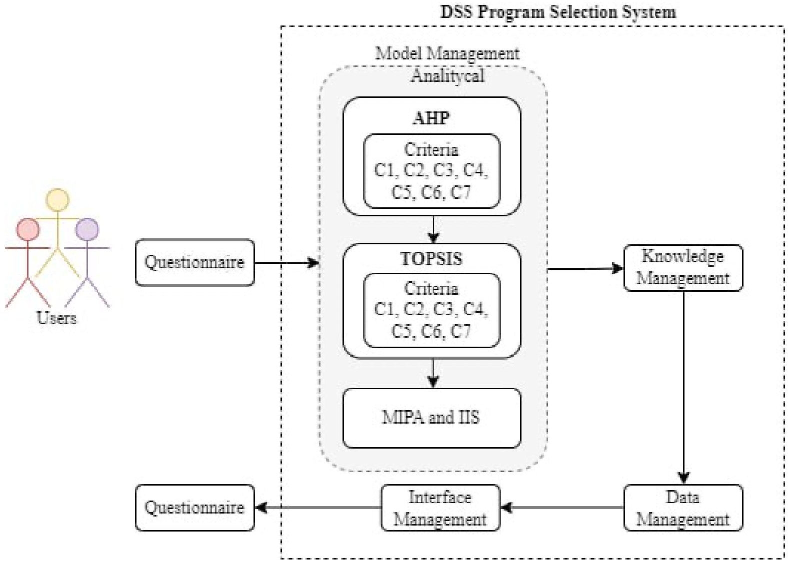

Figure 2. The System Architecture for DSS Study Program Selection

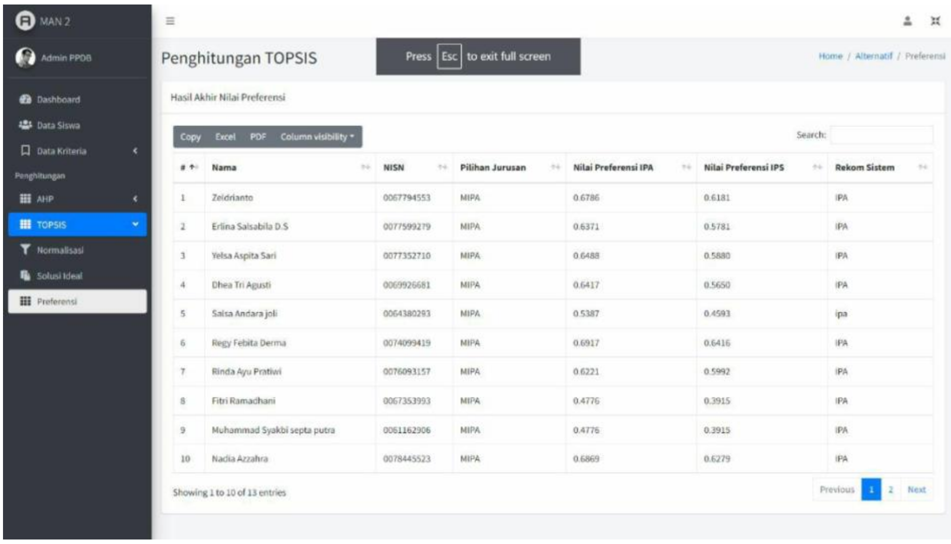

Figure 3. Interface Page for TOPSIS Program Recommendation Analysis

5. CONCLUSION

This study has successfully analyzed the mapping of study program placement for students by considering the criteria viz. student interests, academic report, academic potential test scores, psychological tests, pre-test/post-test, interviews, and teacher recommendations. The AHP approach has succeeded in weighting the significant value of each criterion and sub-criteria, including student interest (0.34) followed by the academic report (0.21), potential academic test (0.14), psychological tests (0.11), Pre-Test / Post-Test (0.09). Interviews (0.06), and teacher recommendations (0.05), respectively. Furthermore, the TOPSIS calculation analysis has succeeded in mapping the appropriate study program for the seventy students based on the calculation value of each criterion against the MIPA and IIS programs. The construction of the AHP and TOPSIS prototypes system has also been successfully developed with the target users from school. The black box testing reveals that this DSS study program selection system runs according to the module's functionality.

Meanwhile, the dissemination of the UAT test to 10 teachers, three parents, and ten students found the benefit of this application in aiding the study program selection at 81.9%, the ease of use interface and pages designed at 88%, and the user satisfaction on system proposed recommendation at 86.5%. This DSS study program selection system, integrating AHP and TOPSIS, suggested the optimal study program according to the student's interests and talents. Herein, the DSS study program selection system hands over a positive contribution to the school, teachers, parents and students in deeply understanding their interests and abilities of students to subsequently be directed into the appropriate curriculum enrichment and learning methodology. Therefore, the student's and school's performance in the future can be further improved and measured.

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