Smart Based Decision Support System (DSS) for Additional Classes

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Abstrak

Kelas tambahan diberikan untuk meningkatkan proses belajar bagi siswa yang nilainya belum memenuhi standar. Namun, masih ada tantangan dalam pemberian kelas tambahan di TK YPPI Kalangsari, yaitu proses penghitungan memerlukan waktu yang lama. Untuk meningkatkan proses tersebut, dibuatlah Sistem Penunjang Keputusan pemberian kelas tambahan berbasis metode Simple Multi-Attribute Rating Technique. Berdasarkan hasil uji coba pada 5 orang siswa TK, sistem mampu menampilkan hasil penghitungan dengan cepat dan mampu memberikan rekomendasi siswa yang harus mengikuti kelas tambahan sesuai dengan kriteria yang ditentukan. Sistem yang dibuat juga mampu menambah data siswa dan kriteria penilaian sesuai kebutuhan.
Kata kunci: *SPK, metode SMART, kelas tambahan*

Abstract

Additional classes are given to enhance learning process for students whose grades do not meet the standards. However, there are challenges remain in giving additional classes at YPPI Kalangsari Kindergarten, namely the calculation process takes a long time. To enhance the process, a Decision Support System for giving additional classes based on the Simple Multi-Attribute Rating Technique method was created. Based on the test results on 5 Kindergarten student, the system can display the calculation results quickly and is able to provide recommendations for students who must take additional classes according to the specified criteria. The system also able to add student data and assessment criteria as needed.
Keywords*: DSS, SMART method, additional classes*

1. Introduction

Student have different characteristics and phase in learning progress [1]. In YPPI Kalangsari Kindergarten, students who have a slower learning phase and have problems in learning need to be given additional classes. Additional classes are learning activities outside the formal study time provided by the teacher for students who have learning difficulties [2], [3]. Based on a survey conducted in preliminary research, student learning outcomes improve after attending additional classes as shown in figure 1.

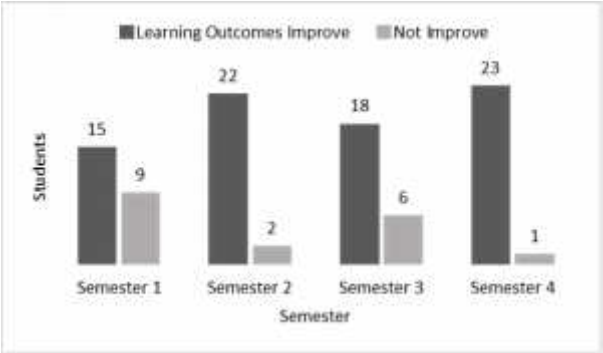

Figure 1. Student Learning Outcomes After Additional Classes

However, there are challenges in the process of calculating the determination of students who must take additional classes, namely the large number of students and many assessment criteria. In YPPI Kalangsari Kindergarten, students who must take additional classes are determined based on religion and

morals, physical motor, social emotional, cognitive, language, and art. On the other hand, the teacher performs calculations based on paper reports. Therefore, the calculation process takes a long time.

To overcome these challenges, this study proposes a Decision Support System (DSS). DSS is a system that provides assistance with interactive tools and allows decision making from a problem, based on the criteria that are owned or there is a basis for assessment [4]. This system belongs to one type of information system that performs various analyzes using available models and processes through a certain mechanism in the hope of producing the best decisions according to the criteria used.

There are several methods that can be applied to decision support systems including the Elimination Et Choix Tradusaint La Realite (ELECTRE) method as in the research conducted by Oktapria and Wibowo [5]. However, this method has a drawback, namely the criteria used are few [6]. In addition, there is the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method as used in the research of Ramdani, Ekojono, and Santoso [7]. However, the TOPSIS method has a drawback, namely that there is no priority weight determination for calculation. The method that is able to perform calculations with many criteria and apply the determination of priority weights is the Simple Multi-Attribute Rating Technique (SMART) method. SMART method is a method or model used to analyze multi-criteria decision making developed by Edward in 1977 [8]. Andri and Candra stated that the SMART method has advantages in selecting decisions with many criteria. Each alternative has a value and weight based on the priority of the criteria [9].

Therefore, the main contribution of this research is the development of a DSS based on the SMART method to determine which students must take additional classes at YPPI Kalangsari Kindergarten.

2. Research Method

2.1. Research Procedure

There are 6 steps procedure in this research, begin with preparation and permission request, data collecting and preliminary analysis, final analysis, conclusion, and report as shown in figure 2.

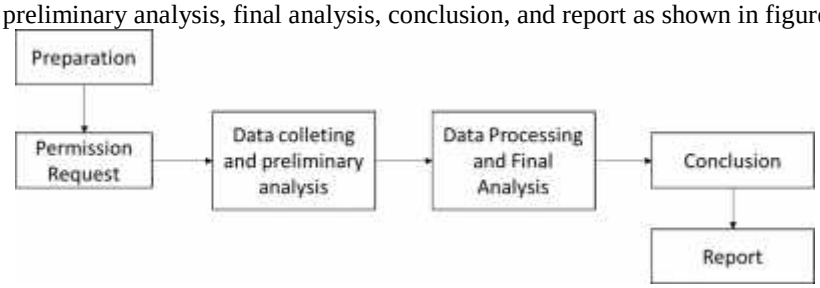

Figure 2. Research Procedure

At the stage of preparation and request for permission, all research needs are prepared and make a request for permission to the object of research. Then, the data needed in the study was collected, namely data on assessment criteria and their weights, as well as student scores for the test. the next stage is the calculation with the smart method and the final analysis. After that, conclusions and report writing are carried out.

2.2. Simple Multi-Attribute Rating Technique (SMART)

There are 7 steps in the SMART method [10]:

1. Determine alternatives and assessment criteria
2. Giving weights on a scale of 1-100 and determine the main criteria
3. Calculate the weight normalization of each criterion by means of the weight score of the criteria divided by the total weight of the criteria as shown in formula 1

$$Normalization = \frac{W_j}{\sum W_j}$$

Where:

W_j : weight score of the criteria
$\sum W_j$: total weight of the criteria

Formula 1. Weight Normalization of Each Criterion

4. Give a criterion score for each alternative. This criterion score can contain qualitative data or quantitative data (numbers). If the data is qualitative, the data must be converted to numerical/quantitative data by making parameter values in the criteria

5. Calculate the utility score by converting the criterion score for each criterion into a standard data criterion score. Criteria with cost categories are calculated by formula 2

$$u_j(a_i) = \frac{(C_{max} - C_{out})}{(C_{max} - C_{min})}$$

Formula 2. Utility Score for Criteria with Cost Categories

For criteria with benefit categories calculated by Formula 3

$$u_j(a_i) = \frac{(C_{out} - C_{min})}{(C_{max} - C_{min})}$$

Formula 3. Utility Score for Criteria with Benefit Categories

Where:

$u_j(a_i)$: utility score criteria j from alternative i
C_{out} : criteria j score
C_{max} : maximum criteria score
C_{min} : minimum criteria score

6. Calculating the final score, by adding up the total multiplication result with the normalized score of the criteria weight as shown in formula 4

$$u(a_i) = \sum_{j=1}^{m} W_j * u_j(a_i)$$

Formula 4. Final Score Formula

Where:

$u(a_i)$: alternative i final score
W_j : criteria weightning normalization score
$u_j(a_i)$: utility score

7. Sort the score from smallest to largest. The alternative that has the smallest score in the specified range is selected

2.3. Criteria and Weighting

The criteria obtained from the semester report are then given a code and weighting score as shown in table 1.

Table 1. Criteria and Weighting

No.	Criteria	Code	Weight Score
1	Religion and Morals	C1	20
2	Physical Motor	C2	20
3	Social Emotional	C3	15
4	Cognitive	C4	25
5	Language	C5	10
6	Art	C6	10

Based on criteria from table 1, define sub-criteria for each criterion as shown in table 2. This sub-criteria will be the assessment indicator.

Table 2. Sub-criteria

No.	Criteria	Sub-criteria
1	Religion and Morals	Believing in Allah SWT through His creation
		Appreciate yourself and others and the surrounding environment as gratitude to Allah SWT
		Have a behavior that reflects an honest attitude
		Get to know daily worship activities
		Carry out daily worship activities with adult guidance
		Recognizing good behavior as a reflection of noble character
		Show polite behavior as a reflection of noble character
2	Physical Motor	Have a behavior that reflects a healthy life
		Recognize body parts, their functions and movements for gross and fine motor development
		Using limbs for gross motor and fine motor development
		Knowing how to live healthy
		Able to help yourself to live healthy
3	Social Emotional	Have a behavior that reflects a confident attitude
		Have behavior that reflects an obedient attitude to daily rules to practice discipline
		Have a behavior that reflects a patient attitude

No.	Criteria	Sub-criteria
		Have behavior that reflects independence
		Have behavior that reflects a caring attitude and is willing to help when asked for help
		Have a behavior that reflects a cooperative attitude
		Have an adaptable behavior
		Have a behavior that reflects an attitude of responsibility
		Recognize the emotions of self and others naturally
		Shows self-emotional reactions naturally
		Recognizing self-needs, wants, and interests
		Express your needs, wants and interests in an appropriate way
4	Cognitive	Have a behavior that reflects an attitude of curiosity
		Have a behavior that reflects a creative attitude
		Able and know how to solve everyday problems and behave creatively
		Solve everyday problems creatively
		Get to know the surrounding objects (name, color, shape, size, pattern, nature, sound, texture, function, and other characteristics)
		Conveys about what and how the objects around him are known (name, color, shape, size, pattern, nature, sound, texture, function, and other characteristics) through various works
		Get to know the social environment (family, friends, place of residence, places of worship, culture, transportation)
		Presenting various works related to the social environment (family, friends, residence, places of worship, culture, transportation) in the form of pictures, storytelling, singing, and gestures
		Get to know the natural environment (animals, plants, weather, soil, water, rocks, etc.)
		Presenting various works related to the natural environment (animals, plants, weather, soil, water, rocks, etc.)
		Familiar with simple technology (household utensils, play equipment, carpentry tools, etc.)
		Uses simple technology to complete tasks and activities (household utensils, play equipment, carpentry tools, etc.)
5	Language	Reflecting a polite attitude towards parents, education, and friends
		Understanding receptive language (listening and reading)
		Demonstrate receptive language skills (listening and reading)
		Understanding expressive language (expressing language verbally and non-verbally)
		Demonstrate expressive language skills (express language verbally and non-verbally)
		Recognizing early literacy through play
		Demonstrate early literacy skills in various forms
6	Art	Have behavior that reflects an aesthetic attitude
		Recognize and produce various artistic works and activities
		Showing artistic works and activities using various media

Furthermore, students will be assessed based on the specified sub-criteria. The score is then converted into a predetermined match rating as shown in the table 3.

Table 3. Match Rating

Score Range	Definition	Match Rating Score
<70	Undeveloped	20
70-81	Start to Develop	20
82-91	Develop As Expected	15
92-100	Develop Very Well	10

There are four definition of score based from table 3. A score of <70 means that the sub-criteria assessed have not developed in students. a score of 70-81 means that the sub-criteria assessed are starting to develop in students. a score of 82-91 means that the sub-criteria assessed are developing according to students' expectations. a score of 92-100 means the sub-criteria that are considered very well developed in students.

2.4. Proposed Workflow

The proposed workflow of system in this research shown in figure 3 below.

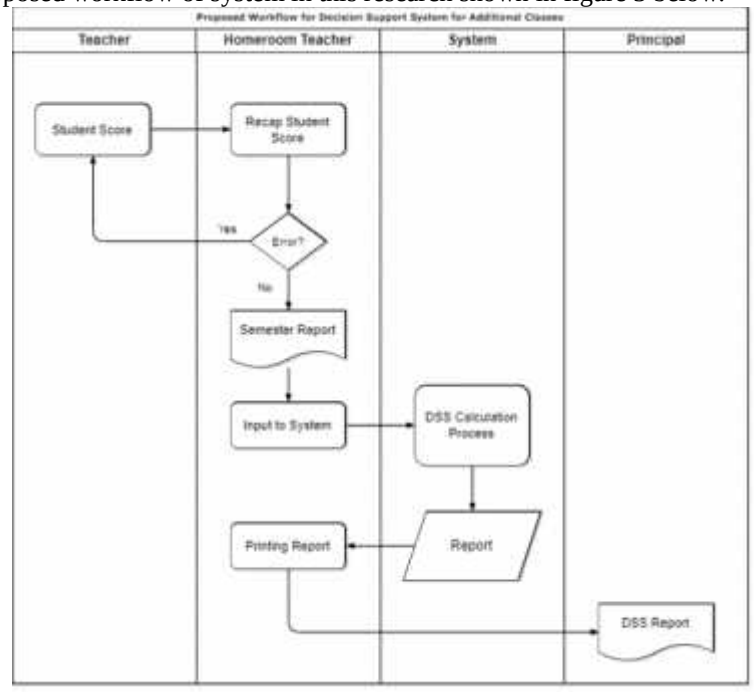

Figure 3. Proposed Workflow

From figure 3, there are four entity in the workflow: teacher, homeroom teacher, system, and principal. First, the teacher will submit student score to homeroom teahcer. If there is no error in the score, homeroom teacher will recap it to semester report and input student score to the system. System will calculate the score based on criteria given, and show the output. Homeroom teacher then print the output to submit to the principal.

3. Results and Analysis

3.1. Weight Normalization, Alternatif Scoring, and Match Rating Calculation

Weight normalization calculation result show in table 4, alternatif scoring show in table 5, and match rating show in table 6.

Table 4. Weight Normalization Calculation Result

No.	Criteria	Weight Score	Result
1	Religion and Morals	20	0.2
2	Physical Motor	20	0.2
3	Social Emotional	15	0.15
4	Cognitive	25	0.25
5	Language	10	0.1
6	Art	10	0.1
	Summary	100	1

Table 5. Alternatif Scoring

Alternatif	C1	C2	C3	C4	C5	C6
Student 1	65	95	50	60	85	90
Student 2	50	75	50	60	85	85
Student 3	50	65	60	60	85	85
Student 4	65	95	65	60	85	80
Student 5	80	65	70	75	75	50

Table 6. Match Rating

Alternatif	C1	C2	C3	C4	C5	C6
Student 1	1	7	1	1	5	5
Student 2	1	3	1	1	5	5
Student 3	1	1	1	1	5	5
Student 4	1	7	1	1	5	3
Student 5	3	1	3	3	3	1

3.2. Utility Score Calculation and Ranking

Utility score calculation result are shown in table 7 and Final ranking are shown in table 8.

Table 7. Utility Score Calculation Result

Alternatif	C1	C2	C3	C4	C5	C6
Student 1	100	0	100	100	0	0
Student 2	100	67	100	100	0	0
Student 3	100	100	100	100	0	0
Student 4	100	0	100	100	0	50
Student 5	0	100	0	0	100	100

The utility value from table 7 is then multiplied by the normalized value of the weight of each criterion. The results of these calculations are then sorted into the final ranking as shown in table 8.

Table 8. Final Ranking

Alternatif	Final Score	Rank
Student 3	80	1
Student 2	73.33	2
Student 4	65	3
Student 1	60	4
Student 5	40	5

Based on the results of the ranking in table 8, the recommended alternative to take additional classes at TK YPPI Kalangsari is Student 3 with a score of 80.

3.3. System Implementation

The system is implemented in a web-based application. In this system, user can add or remove student data, criteria data, and the most important feature, perform calculations to determine students who must attend additional classes as shown in figure 3-4.

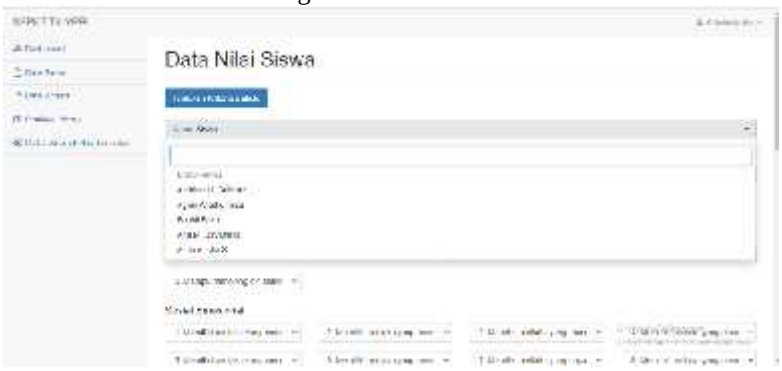

Figure 3. Add or Remove Data

Figure 4. Final Score Ranking

4. Conclusion

The SMART method-based decision support system was successfully created and was able to overcome the challenges mentioned in the introduction, namely the number of students to be assessed, many criteria, and paper-based reports. With this system, the teacher simply inputs student scores and criteria to get recommendation results. For further research, SMART method can be combined with other methods to get better results.

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