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Decision Support System to Determine the Achievement of Students Using Simple Multi-Attribute Rating Technique (SMART)

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Abstract

The problem is in determining the achievement of students by organizing the consultation between teachers. The purpose of this research is to assist the decision-making process of determining the achievement of students with SMART method implementation. The methods of collecting data are interviews, documentation, and observations. The method of system development used is the waterfall method by using the system design tools in the form of DFD and ERD. The software used in the creation of this application is Visual Studio and SQL server express. The results of this study are SMART ranking methods. The decision support process is more objective because it complies with predefined criteria.

Keywords: outstanding students; Waterfall; SMART.

1. Introduction

The background of this research is to assist the curriculum in determining the achievement of students at Ta'allumul Huda Islamic High School in Bumiayu using SMART methods that are implemented into a desktop-based computer application to be more objective and efficient. In the process of determining students ' achievement at Ta'allumul Huda Islamic High School in Bumiayu is still manual to process all calculations, one of which is the calculation to determine the average score of lessons that will be added with a consensus from the results of meetings of teachers and the guardians of the class that will then be obtained by the result of the report. This result only uses one parameter, i.e., the average value of the subject will then be held deliberation to get the outcome of achieving students. A considerable number of students will take a long time in their determination so that the DSS is needed to help the outstanding student selection process.

2. Literature Overview

2.1. Simple Multi-Attribute Rating Technique (SMART) method

SMART (Simple Multi-Attribute Rating Technique) is a method of Multi-criteria decision-making developed by Edward in the year 1977 [1][2]. This multi-criteria decision-making technique is based on the theory that each alternative consists of several criteria that have values, and each criterion has weights that illustrate how important it is compared to other criteria. It is used to assess each alternative for the best alternative[3][4].

$$Maximize = \sum_{j=1}^{k} w_j \cdot u_{ij}, \forall i = 1, \ldots, n$$

a. W_J is weighted to – J criterion of k criteria.

b. U_{ij} is the other utility value i on criterion J.

c. The decision selection is identifying which of the *n* alternatives have the most significant function value.

d. The value of this function can also be used to render *n* alternative.

2.2. System Development Methods

The SDLC waterfall model is often also called a linear sequential model. The waterfall model provides a sequential flow of software approach from analysis, design, coding, testing, and support phase [5].

3. Results and Discussion

3.1. Example of calculation using Simple Multi-Attribute Rating Technique (SMART)

Specifying an alternative, i.e., Ai, table 1 shows the names of outstanding prospective students at the end of the process will be taken from the most decent to less decent.

Table 1. Alternate Table

Alternative	Name
5311	ALMA SHOFIANADA ZULYA
5312	ANA AENITA SUCIATI
5313	ANISA NUR ISTIQOMAH
5314	AQIL KAMAL MAKARIM
5315	AVI TRIANA
5316	AYISHA DEWI SALSABILA
5318	DEVY FITRIANA
5319	DIANTI PERTIWI
5320	DINDA NOPIANI
5321	ERINA SYAFA AZ ZAHRA
5341	ERICA VIDYA ZIHAN PERTIWI
5344	AJENG LINTANG PERMATA ARMY
5345	ARYA DWIKI RIZKYANSYAH
5346	BOBI PRATAMA
5347	DINA ROHMATIKA
5348	ELZA KHONITA
5349	ETLA NISA ULJANAH
5350	FAIZ ARDHO WILDAN
5351	FAJAR MERRYANA RAHMAWATI
5383	AENI ZAHRA ZANATIN
5384	AGNES VIRANI
5385	ATIKA SILVIA
5386	AULIA PUTRI PUSPITA DEWI
5387	DEN SULTHAN BAGUS PANGLIMA
5388	DHIANDA MAULIDA FADILLA
5389	DITA CAHAYATININGSIH
5390	DITTA MELYNIA RAHARJO
5391	FIGNI OKTAVIANI
5392	IHZA AGAM MUHAMMAD
5400	MELI AGUSTIN
5401	MELINA RETA ISTIANI
5422	AIDAUS SALAMAH
5424	AULIA ISNA FARIDA
5425	BAETY SALAMAH
5426	DEWI ANGGRAENI PUTRI GURITNO
5427	DIAH SEPTI LESTARI
5428	DINDA DIYANTARI PRAJA
5429	ELLIN IGNA NAISICHA
5430	FARKHAN NUR ISKANDAR HAQIQI
5441	AKHMAD GIOPANI
5460	ANGGITA FRISKA SAPUTRI
5461	AZMI RAHMAN IRFANTO
5462	BELA NOVIANA PUTRI
5463	DELLA PADILA WULANDARI
5464	DHELIA GITA SAFITRI
5465	DWI ROSMAWATI
5467	FIA ILFANI

Alternative	Name
5468	HANA NURFAUZIAH

The next step is to determine the criteria that will be used as a reference in decision making, namely Ci[6]. Based on determining the criteria that have been done through interviews with the principal, the following criteria are produced:

Table 2. Criteria Table Determining Prospective Students' Achievement

Criteria Name	Criteria
C1	Average Rating
C2	Presence
C3	Social Attitudes
C4	Spiritual Attitude
C5	Non - academic Achievement

Then weight -giving for each required criterion.

Table 3. Average Value Criteria Weight

Average Rating	Weights
90 – 100	5
80 - 89	4
70 - 79	3
60 – 69	2
< 59	1

Table 4. Presence Criteria Weight

Absence	Weights
0	5
1 - 3	4
4 - 8	3
9 - 12	2
> 12	1

Table 5. Social Attitudes Criteria Weight

Social Attitudes	Weights
A	5
B	4
C	3

Table 6. Spiritual Attitudes Criteria Weight

Spiritual Attitude	Weights
A	5
B	4
C	3

Table 7. Spiritual Attitudes Criteria Weight

Non-academic Achievement	Weights
0 Achievements	1
1 Achievements	5
> = 3 achievements	10

The match rating data from each of the alternatives in each criterion can be seen in the table below:

Table 8. The Match Rating of Each Alternative to Each Criterion

Alternative	Name	C1	C2	C3	C4	C5
5311	ALMA SHOFIANADA ZULYA	4	5	5	5	1
5312	ANA AENITA SUCIATI	5	4	5	5	5
5313	ANISA NUR ISTIQOMAH	5	5	5	4	5
5314	AQIL KAMAL MAKARIM	4	4	5	5	1
5315	AVI TRIANA	4	4	4	5	1
5316	AYISHA DEWI SALSABILA	5	5	5	5	1
5318	DEVY FITRIANA	4	5	5	4	1
5319	DIANTI PERTIWI	4	4	5	4	1
5320	DINDA NOPIANI	5	5	4	5	1
5321	ERINA SYAFA AZ ZAHRA	4	4	4	5	1
5341	ERICA VIDYA ZIHAN PERTIWI	4	5	4	5	1
5344	AJENG LINTANG PERMATA ARMY	4	4	5	4	1
5345	ARYA DWIKI RIZKYANSYAH	4	4	5	4	1
5346	BOBI PRATAMA	4	5	5	4	1
5347	DINA ROHMATIKA	4	4	4	5	1
5348	ELZA KHONITA	4	5	5	4	1
5349	ETLA NISA ULJANAH	5	5	5	4	1
5350	FAIZ ARDHO WILDAN	4	4	5	4	1
5351	FAJAR MERRYANA RAHMAWATI	4	5	4	5	1
5383	AENI ZAHRA ZANATIN	4	4	5	4	1
5384	AGNES VIRANI	4	5	5	4	1
5385	ATIKA SILVIA	4	5	4	5	1
5386	AULIA PUTRI PUSPITA DEWI	4	4	4	5	1
5387	DEN SULTHAN BAGUS PANGLIMA	4	4	5	4	1
5388	DHIANDA MAULIDA FADILLA	4	4	4	5	1
5389	DITA CAHAYATININGSIH	4	5	5	4	1
5390	DITTA MELYNIA RAHARJO	4	5	5	4	1
5391	FIGNI OKTAVIANI	4	4	5	5	1
5392	IHZA AGAM MUHAMMAD	4	4	5	4	1
5400	MELI AGUSTIN	4	4	4	5	1
5401	MELINA RETA ISTIANI	4	5	5	4	1
5422	AIDAUS SALAMAH	4	3	5	4	1
5424	AULIA ISNA FARIDA	4	4	4	5	1
5425	BAETY SALAMAH	4	4	5	4	1
5426	DEWI ANGGRAENI PUTRI GURITNO	4	3	4	5	1
5427	DIAH SEPTI LESTARI	4	4	5	4	1
5428	DINDA DIYANTARI PRAJA	4	5	5	4	1
5429	ELLIN IGNA NAISICHA	4	5	4	5	1
5430	FARKHAN NUR ISKANDAR HAQIQI	4	4	5	4	1
5441	AKHMAD GIOPANI	4	4	5	4	5
5460	ANGGITA FRISKA SAPUTRI	5	4	5	5	1
5461	AZMI RAHMAN IRFANTO	5	4	5	5	1
5462	BELA NOVIANA PUTRI	5	5	5	5	1
5463	DELLA PADILA WULANDARI	5	5	5	5	1
5464	DHELIA GITA SAFITRI	5	4	5	5	1
5465	DWI ROSMAWATI	5	5	5	5	1
5467	FIA ILFANI	4	5	4	5	1
5468	HANA NURFAUZIAH	5	5	5	4	1

Decision-makers provide weight preference as follows:

W = (20%,20%,20%,20%,20%)[7]. Then, done the value of utilities based on the equation below, but before doing the calculation must first determine the min and max values on each criterion and below Is the formula determination value utility:

If Cost, then:

$$cost = \left(\frac{Cmax - Cout}{Cmax - Cmin}\right) X\ 100\%$$

If Benefit, then:

$$benefit = \left(\frac{Cout - Cmin}{Cmax - Cmin}\right) X\ 100\%$$

Table 9. Utility Value

Alternative	Name	C1	C2	C3	C4	C5
5311	ALMA SHOFIANADA ZULYA	0	1	1	1	0
5312	ANA AENITA SUCIATI	1	0.5	0.2	1	1
5313	ANISA NUR ISTIQOMAH	1	1	0.2	0	1
5314	AQIL KAMAL MAKARIM	0	0.5	0.2	1	0
5315	AVI TRIANA	0	0.5	0	1	0
5316	AYISHA DEWI SALSABILA	1	1	0.2	1	0
5318	DEVY FITRIANA	0	0.5	0.2	0	0
5319	DIANTI PERTIWI	0	0.5	0.2	0	0
5320	DINDA NOPIANI	1	1	0	1	0
5321	ERINA SYAFA AZ ZAHRA	0	0.5	0	1	0
5341	ERICA VIDYA ZIHAN PERTIWI	0	1	0	1	0
5344	AJENG LINTANG PERMATA ARMY	0	0.5	0.2	0	0
5345	ARYA DWIKI RIZKYANSYAH	0	0.5	0.2	0	0
5346	BOBI PRATAMA	0	1	0.2	0	0
5347	DINA ROHMATIKA	0	0.5	0	1	0
5348	ELZA KHONITA	0	1	0.2	0	0
5349	ETLA NISA ULJANAH	1	1	0.2	0	0
5350	FAIZ ARDHO WILDAN	0	0.5	0.2	0	0
5351	FAJAR MERRYANA RAHMAWATI	0	1	0	1	0
5383	AENI ZAHRA ZANATIN	0	0.5	0.2	0	0
5384	AGNES VIRANI	0	1	0.2	0	0
5385	ATIKA SILVIA	0	1	0	1	0
5386	AULIA PUTRI PUSPITA DEWI	0	0.5	0	1	0
5387	DEN SULTHAN BAGUS PANGLIMA	0	0.5	0.2	0	0
5388	DHIANDA MAULIDA FADILLA	0	0.5	0	1	0
5389	DITA CAHAYATININGSIH	0	1	0.2	0	0
5390	DITTA MELYNIA RAHARJO	0	1	0.2	1	0
5391	FIGNI OKTAVIANI	0	0.5	0.2	1	0
5392	IHZA AGAM MUHAMMAD	0	0.5	0.2	0	0
5400	MELI AGUSTIN	0	0.5	0	1	0
5401	MELINA RETA ISTIANI	0	1	0.2	0	0
5422	AIDAUS SALAMAH	0	0	0.2	0	0
5424	AULIA ISNA FARIDA	0	0.5	0	1	0
5425	BAETY SALAMAH	0	0.5	0.2	0	0
5426	DEWI ANGGRAENI PUTRI GURITNO	0	0	0	1	0
5427	DIAH SEPTI LESTARI	0	0.5	0.2	0	0
5428	DINDA DIYANTARI PRAJA	0	1	0.2	0	0
5429	ELLIN IGNA NAISICHA	0	1	0	1	0
5430	FARKHAN NUR ISKANDAR HAQIQI	0	0.5	0.2	0	0
5441	AKHMAD GIOPANI	0	0.5	0.2	0	1
5460	ANGGITA FRISKA SAPUTRI	1	0.5	0.2	1	0
5461	AZMI RAHMAN IRFANTO	1	0.5	0.2	1	0
5462	BELA NOVIANA PUTRI	1	1	0.2	1	0
5463	DELLA PADILA WULANDARI	1	1	0.2	1	0
5464	DHELIA GITA SAFITRI	1	0.5	0.2	1	0
5465	DWI ROSMAWATI	1	1	0.2	1	0
5467	FIA ILFANI	0	1	0	1	0

Alternative	Name	C1	C2	C3	C4	C5
5468	HANA NURFAUZIAH	1	1	0.2	0	0

The next process is the determination of the final value, the calculation formula of the final value is (NA = value utility of each criteria X normalized weight) with the following result:

Table 10. Final Value

Alternative	Name	C1	C2	C3	C4	C5
5311	ALMA SHOFIANADA ZULYA	0	0.2	0.2	0.2	0
5312	ANA AENITA SUCIATI	0.2	0.1	0.04	0.2	0.2
5313	ANISA NUR ISTIQOMAH	0.2	0.2	0.04	0	0.2
5314	AQIL KAMAL MAKARIM	0	0.1	0.04	0.2	0
5315	AVI TRIANA	0	0.1	0	0.2	0
5316	AYISHA DEWI SALSABILA	0.2	0.2	0.04	0.2	0
5318	DEVY FITRIANA	0	0.1	0.04	0	0
5319	DIANTI PERTIWI	0	0.1	0.04	0	0
5320	DINDA NOPIANI	0.2	0.2	0	0.2	0
5321	ERINA SYAFA AZ ZAHRA	0	0.1	0	0.2	0
5341	ERICA VIDYA ZIHAN PERTIWI	0	0.2	0	0.2	0
5344	AJENG LINTANG PERMATA ARMY	0	0.1	0.04	0	0
5345	ARYA DWIKI RIZKYANSYAH	0	0.1	0.04	0	0
5346	BOBI PRATAMA	0	0.2	0.04	0	0
5347	DINA ROHMATIKA	0	0.1	0	0.2	0
5348	ELZA KHONITA	0	0.2	0.04	0	0
5349	ETLA NISA ULJANAH	0.2	0.2	0.04	0	0
5350	FAIZ ARDHO WILDAN	0	0.1	0.04	0	0
5351	FAJAR MERRYANA RAHMAWATI	0	0.2	0	0.2	0
5383	AENI ZAHRA ZANATIN	0	0.1	0.04	0	0
5384	AGNES VIRANI	0	0.2	0.04	0	0
5385	ATIKA SILVIA	0	0.2	0	0.2	0
5386	AULIA PUTRI PUSPITA DEWI	0	0.1	0	0.2	0
5387	DEN SULTHAN BAGUS PANGLIMA	0	0.1	0.04	0	0
5388	DHIANDA MAULIDA FADILLA	0	0.1	0	0.2	0
5389	DITA CAHAYATININGSIH	0	0.2	0.04	0	0
5390	DITTA MELYNIA RAHARJO	0	0.2	0.04	0	0
5391	FIGNI OKTAVIANI	0	0.1	0.04	0.2	0
5392	IHZA AGAM MUHAMMAD	0	0.1	0.04	0	0
5400	MELI AGUSTIN	0	0.1	0	0.2	0
5401	MELINA RETA ISTIANI	0	0.2	0.04	0	0
5422	AIDAUS SALAMAH	0	0	0.04	0	0
5424	AULIA ISNA FARIDA	0	0.1	0	0.2	0
5425	BAETY SALAMAH	0	0.1	0.04	0	0
5426	DEWI ANGGRAENI PUTRI GURITNO	0	0	0	0.2	0
5427	DIAH SEPTI LESTARI	0	0.1	0.04	0	0
5428	DINDA DIYANTARI PRAJA	0	0.2	0.04	0	0
5429	ELLIN IGNA NAISICHA	0	0.2	0	0.2	0
5430	FARKHAN NUR ISKANDAR HAQIQI	0	0.1	0.04	0	0
5441	AKHMAD GIOPANI	0	0.1	0.04	0	1
5460	ANGGITA FRISKA SAPUTRI	0.2	0.1	0.04	0.2	0
5461	AZMI RAHMAN IRFANTO	0.2	0.1	0.04	0.2	0
5462	BELA NOVIANA PUTRI	0.2	0.2	0.04	0.2	0
5463	DELLA PADILA WULANDARI	0.2	0.2	0.04	0.2	0
5464	DHELIA GITA SAFITRI	0.2	0.1	0.04	0.2	0
5465	DWI ROSMAWATI	0.2	0.2	0.04	0.2	0
5467	FIA ILFANI	0	0.2	0	0.2	0
5468	HANA NURFAUZIAH	0.2	0.2	0.04	0	0

Table 11. Decision-making Rank

Alternative	Name	Average	Rank
5311	ALMA SHOFIANADA ZULYA	0.6	7
5312	ANA AENITA SUCIATI	0.74	1
5313	ANISA NUR ISTIQOMAH	0.64	2
5314	AQIL KAMAL MAKARIM	0.34	19
5315	AVI TRIANA	0.3	22
5316	AYISHA DEWI SALSABILA	0.64	2
5318	DEVY FITRIANA	0.14	37
5319	DIANTI PERTIWI	0.14	37
5320	DINDA NOPIANI	0.6	7
5321	ERINA SYAFA AZ ZAHRA	0.3	22
5341	ERICA VIDYA ZIHAN PERTIWI	0.4	14
5344	AJENG LINTANG PERMATA ARMY	0.14	37
5345	ARYA DWIKI RIZKYANSYAH	0.14	37
5346	BOBI PRATAMA	0.24	29
5347	DINA ROHMATIKA	0.3	22
5348	ELZA KHONITA	0.24	29
5349	ETLA NISA ULJANAH	0.44	12
5350	FAIZ ARDHO WILDAN	0.14	37
5351	FAJAR MERRYANA RAHMAWATI	0.4	14
5383	AENI ZAHRA ZANATIN	0.14	37
5384	AGNES VIRANI	0.24	29
5385	ATIKA SILVIA	0.4	14
5386	AULIA PUTRI PUSPITA DEWI	0.3	22
5387	DEN SULTHAN BAGUS PANGLIMA	0.14	37
5388	DHIANDA MAULIDA FADILLA	0.3	22
5389	DITA CAHAYATININGSIH	0.24	29
5390	DITTA MELYNIA RAHARJO	0.24	29
5391	FIGNI OKTAVIANI	0.34	19
5392	IHZA AGAM MUHAMMAD	0.14	37
5400	MELI AGUSTIN	0.3	22
5401	MELINA RETA ISTIANI	0.24	29
5422	AIDAUS SALAMAH	0.04	48
5424	AULIA ISNA FARIDA	0.3	22
5425	BAETY SALAMAH	0.14	37
5426	DEWI ANGGRAENI PUTRI GURITNO	0.2	36
5427	DIAH SEPTI LESTARI	0.14	37
5428	DINDA DIYANTARI PRAJA	0.24	29
5429	ELLIN IGNA NAISICHA	0.4	14
5430	FARKHAN NUR ISKANDAR HAQIQI	0.14	37
5441	AKHMAD GIOPANI	0.34	19
5460	ANGGITA FRISKA SAPUTRI	0.54	9
5461	AZMI RAHMAN IRFANTO	0.54	9
5462	BELA NOVIANA PUTRI	0.64	2
5463	DELLA PADILA WULANDARI	0.64	2
5464	DHELIA GITA SAFITRI	0.54	9
5465	DWI ROSMAWATI	0.64	2
5467	FIA ILFANI	0.4	14
5468	HANA NURFAUZIAH	0.44	12

3.2. System Implementation

When implemented into the application will be the following image:

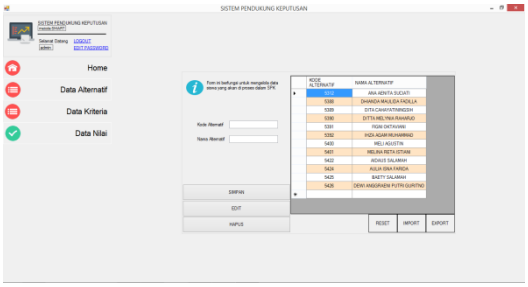

Fig 1. Alternative interface

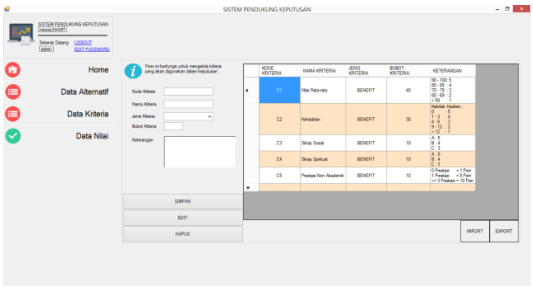

Fig 2. Criteria Interface

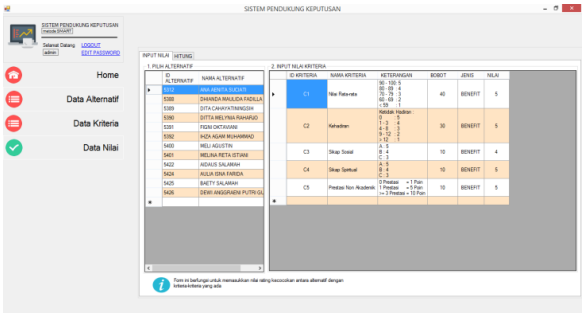

Fig. 3 Data interface Tabulation value input

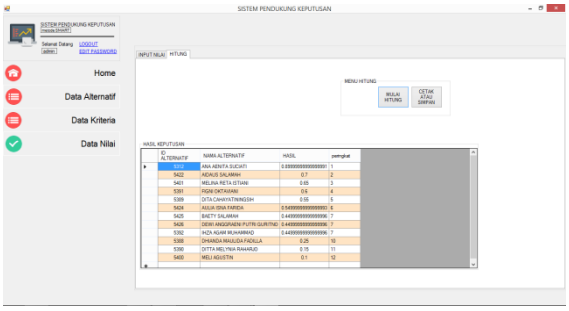

Fig. 4 Data interface count tabulation value

Fig. 5 Home interface

4. Conclusion

Based on the results and description of the previous discussion about the decision support system of determining the achievement of achieving the Simple Multi-Attribute Rating Technique (SMART) at Ta'allumul Huda Islamic High School in Bumiayu, it can be taken a few conclusions as follows:

a. Has successfully created a decision support system application using the SMART method. Which of the test results manually with testing in the application found similar results.

b. The decision-making process is more objective because it complies with the criteria specified for Outstanding student selection.

c. This application can help the student part in calculating The feasibility of determining the achievement of students.

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