IMPLEMENTATION OF THE SMART METHOD IN THE DECISION SUPPORT SYSTEM FOR PENALTY RECOMMENDATIONS

Novita Br Ginting1*; Dahlia Widhyaestoeti 2; Jejen Jaenuddin 3; Fitria Rachmawati4; Yusup Maolani5

Information System Study Program 1234, Informatic Engineering Study Program5
Ibn Khaldun University Bogor
https://www.uika-bogor.ac.id
novitawahab@uika-bogor.ac.id 1*,dahlia@uika-bogor.ac.id-2, zen@uika-bogor.ac.id-3, fitria@uika-bogor.ac.id-4, yusup17maolani@gmail.com-5

(*) Corresponding Author

Abstract—Sanctions need to be given to students who do not obey school rules, and the purpose is to establish student discipline and ethics. SMK Gazza Wiguna 1 Megamendung Bogor district also imposes sanctions for students who violate the rules of conduct. The problem is that determining the violation point has not been done objectively. To overcome this, applying the Simple Multi-Attribute Rating Technique Method (SMART) method to the decision support system to determine recommendations for sanctions for students who commit violations. This system is designed to use UML tools and is built on a web basis. The system uses an alternative oral warning, first warning letter, second warning letter, third warning letter, and returned to parents (DO). The criteria include violation of school uniforms, tidiness, discipline, cleanliness, order, hospitality, commemorating national holidays, and additional provisions. The type of criteria used is the cost criteria because it is expected that students do not violate school rules; if students commit violations, it is hoped that students do not commit serious transgressions.

Keywords: decision support system; penalty; SMART method; Information System

Abstrak—*Pemberian sanksi perlu dilakukan bagi siswa yang tidak taat pada tata tertib sekolah, tujuannya adalah untuk membentuk disiplin dan budi pekerti siswa. SMK Gazza Wiguna 1 Megamendung kab. Bogor pun memberlakukan sanksi bagi siswa yang melakukan pelanggaran terhadap tata tertib. Permasalahannya adalah penetapan point pelanggaran masih belum dilakukan secara objektif. Untuk mengatasi hal tersebut maka penerapan metode Simple Multi Attribute Rating Technique Method (SMART) pada system penunjang keputusan untuk menentukan rekomendasi sanksi pada siswa yang melakukan pelanggaran. System ini dirancang menggunan tool UML, dan system dibangun berbasis web. System ini menggunakan alternatif peringatan lisan, surat peringatan pertama, surat peringatan kedua, surat peringatan ketiga, dan dikembalikan ke orang tua (DO), dan kriteria terdiri dari pelanggaran seragam sekolah, kerapihan, disiplin, kebersihan dan ketertiban, tata krama, peringatan hari besar nasional, dan ketentuan tambahan. Jenis kriteria yang digunakan adalah cost kriteria, karena diharapkan siswa tidak melakukan pelanggaran terhadap tata tertib sekolah, bila siswa melakukan pelanggaran, diharapakan siswa tidak melakukan pelanggaran yang berat.*

Kata Kunci: : sistem penunjang keputusan; sanksi; SMART method; system informasi.

INTRODUCTION

Habituation of positive attitudes and behaviours in schools can be done through Ethics Growth activities such as 1) fostering the development of moral and spiritual values, 2) promoting the development of national importance and diversity, 3) developing positive interactions between students and teachers and parents, 4) taking care of themselves and the school environment, 5) developing the full potential of students, 6) involving parents and the community in schools [1]. For Ethics Growth habituation, schools need to enforce discipline to train students in self-control to be responsible and not affected by negative things [2][3]. The application of discipline in schools, especially for students, really needs to be taken seriously. The application of penalty is independent of punishment as a control for students who do not obey the established school rules. Discipline aims to educate students not to make the same mistakes so that the character of students with good ethics is formed [4]–[6].

SMK Gazza Wiguna 1 Megamendung Bogor regency is a private school that applies discipline and punishment in shaping the ethical character of

its students. Referring to the Decree of Principal Number: 421.7/026/SMKGW1/VII/2020 concerning Rules and Regulations for the Social Life of Schools of Students in SMK Gazza Wiguna 1 Megamendung regarding Violations and Sanctions, every violation committed by students will be given sanctions in the form of oral warnings, first, second, third written warnings, and dropouts known by parents [7]–[9].

The problem faced by picket teachers determines the point and punishment of violations in a feeling only so that there is a less objective determination of penalties. Besides, student violation data is recorded manually in the violation book. As a result, student coaching is challenging. Finding information is difficult because the data is recorded manually. Regarding this problem, SMK Gazza Wiguna 1 Megamendung wants a decision-supporting system to help school management manage student breach data to decide the suitable student penalty and the right coaching. This study aims to apply the SMART (Simple Multi-Attribute Rating Technique) method to the decision support system. The decision support system can record violations, give offenders weight, and produce output through sanctions recommendations. These recommendations will be material for school management in establishing sanctions that will be given to students who commit violations.

The SMART method is multi-criteria decision-making. In the SMART process, each alternative consists of several criteria and has a weight value that describes its importance compared to other measures. Weighting assesses each alternative to obtain the best alternative [10]. Another study used the SMART method to determine toddlers' growth and skinning criteria [11]. SMART method Determining the quality of clothing materials following consumer demands, consumers give the value professionally [12]. The selection of satellite system vendors applying twelve criteria for implementing the SMART method can be used to improve group decision-making [13]. The SMART method is also used for e-marketplace selection using Business View, Market Service View, Third-party B2B E-marketplace performance, Transaction View, and Infrastructure e View tools. Assessment is carried out by giving the value of the weight of the criteria quantitatively [14]. The SMART method is implemented in determining the level of drug addiction, with the criteria The frequency of Drug Use, History (Old) of Drug Use, Amount of Drug Use, Alcohol Screening Value, and Narcotics Screening Score. Alternative hatching using a qualitative manner is with light, medium, and heavy values [15].

Referring to literature that has applied the SMART method in solving multi-criteria problems,

the problem of sanctioning students with multi-criteria can be solved by the application of the SMART method and to facilitate. The SMART process can be integrated into the decision support system.

MATERIALS AND METHODS

The research methodology uses the Waterfall method, as shown in figure 1. Calculation analysis using the SMART (Simple Multi-Attribute Rating Technique) method, shown in figure 2.
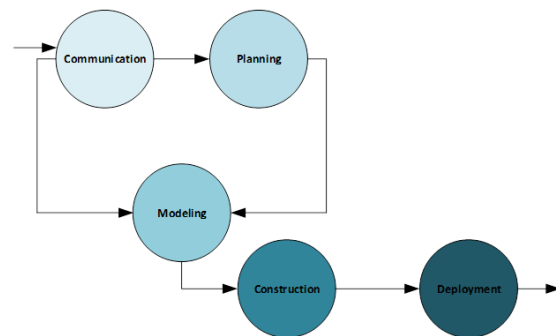

Figure 1. Research method [16]

Communication
Communication is carried out to understand the system that runs in the application of sanctions. Communication is carried out through interviews and observations of stakeholders, namely the principal, vice principal for student affairs, counselling teachers, picket officer teachers, and students. The need for data to analyze and build a system is also communicated at this stage.

Planning
At this stage, planning is carried out using methods to solve the problem of calculating the value of violations and planning the construction of the system. At this stage, SMK Gazza Wiguna 1, as the owner of the system, conducts elicitation, elaboration, negotiation, specifications, and validation, of the use of problem-solving models and strategies to be built

Modeling
At the modeling stage, a test of the application of the SMART method is carried out. The analysis step with the SMART process is shown in figure 2. The decision support system (DSS) design is also carried out at this stage. The system design method uses an object-oriented design with the Unified Modelling Language (UML) design tool.

Construction
DSS application development and application tests are carried out in the construction

stage. Applications are built with PHP programming language, database server MySQL, web service using Xampp v.3.3.0, and web browser using google chrome.

Deployment

At this stage, system installation is carried out at SMK Gazza Wiguna 1. Users test the system, delivery, support, and feedback.
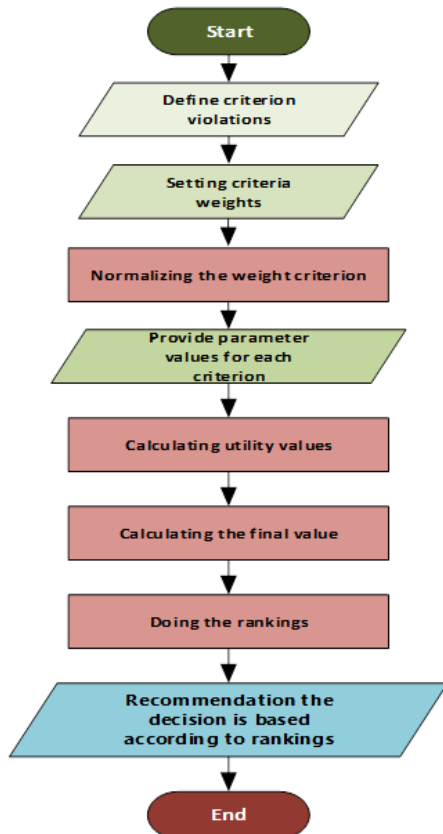

Figure 2. Stages of analysis with the SMART method

RESULTS AND DISCUSSION

This research was conducted based on the waterfall research method, as shown in figure 1. The data used in this study are 1) data on the regulation of the principal's decree number 421.7/026/SMKGW1/VII/2020, 2) picket teacher data, 3) student data, and 4) breach case book data. Then the alternative sanctions given to students who commit violations are shown in table 1.

Table 1. Data of Alternative

No	Penalty code	Penalty name	Range Point
1	PL	Verbal warnings	10-24
2	SP1	First warning letter	25-50
3	SP2	Second warning letter	51-80
4	SP3	Third warning letter	81-90
5	DO	Drop out	91->=100

The SMART method can be applied to obtain penalty recommendations. The steps performed refer to figure 2.

Step 1. Define criterion violations
Then the criteria for violation are shown in table 2.

Table 2. Data of criterion

No	Criterion Code	Criterion Name
1	P1	School Uniform
2	P2	Tidiness
3	P3	Discipline
4	P4	Cleanliness and Order
5	P5	Manners
6	P6	National holidays and memorials
7	P7	Additional Term

Step 2. Setting criteria weights
The principal has determined the value of the weight of the criteria based on decree number: 421.7/026/SMKGW1/VII/2020. The weight values are shown in table 3.

Table 3. the weight of the criterion

No	Criterion Code	Criterion Name	Weight
1	P1	School Uniform	5
2	P2	Tidiness	5
3	P3	Discipline	15
4	P4	Cleanliness and Order	5
5	P5	Manners	10
6	P6	National holidays and memorials	10
7	P7	Additional Term	50
		Amount	100

Step 3. Normalizing the weight of the criterion
After determining the weight of the criteria, the next step is normalized by following the formula equation 1. The result normalizing the importance of the measure is shown in table 4.

$$W_i = \frac{W_i'}{\sum_{j=1}^{m} W_j} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

W_i = The weight of the criteria is normalized for the i-th criterion.
W_i' = The weight of the i-th criterion.
W_j = The weight of the j-th criterion.
j = 1,2,3,...,m number of criteria.
Example

Table 4. Result normalizing the weight criterion

No	Criterion Code	Criterion Name	Weight	W'_i
1	P1	School Uniform	5	0.05
2	P2	Tidiness	5	0.05
3	P3	Discipline	15	0.15
4	P4	Cleanliness and Order	5	0.05
5	P5	Manners	10	0.1
6	P6	National holidays and memorials	10	0.1
7	P7	Additional Term	50	0.5

Step 4. Provide parameter values for each criterion. This research uses quantitative values. Grades are obtained through a picket teacher representative and recorded in the book of violations. The parameter values for each measure are shown in Table 5.

Table 5. The parameter values for each criterion

Alternative Code	Criterion Code						
	P1	P2	P3	P4	P5	P6	P7
PL	5	5	10	5	20	30	50
SP1	10	10	20	15	30	50	75
SP2	15	30	30	30	50	50	80
SP3	20	30	40	30	75	50	90
DO	25	30	80	40	80	50	100

Step 5. Calculating utility values.
Calculate utility values by converting the criteria values on each measure into standard data criteria values. The utility value uses cost criteria because the requirements are "more desirable small values" than calculating utility value by following the formula equation 2.

$$\cup_i(ai) = \frac{(C_{max} - C_{out})}{C_{max} - C_{min}} \quad \text{...............(2)}$$

$\cup_i(ai)$ = i-th criteria utility value for an i-th alternative.
C_{max} = maximum criterion value.
C_{min} = minimum criterion value.
C_{out} = i-th criterion value.
Example
$\cup_i(ai) = \frac{(25-5)}{(25-25)} = \frac{20}{20} = 1$.

The result calculating the utility value is shown in figure 6.

Table 6. Utility Values

Alternative code	Criterion Code						
	P1	P2	P3	P4	P5	P6	P7
PL	1	1	1	1	1	1	1
SP1	0.75	0.8	0.85	0.75	0.83	0	0.5
SP2	0.5	0	0.71	0.28	0.5	0	0.4
SP3	0.25	0	0.57	0.28	0.083	0	0.2
DO	0	0	0	0	0	1	0

After getting the utility value, calculate the final value using the formula equation 3.

$$\cup(a_i) \sum_{j=1}^{m} w_j * u_{j(ai)} \quad \text{...............(3)}$$

$\cup(a_i)$ = The total value for the i-th alternative.
w_j = The already normalized value of the j-th criterion weight.
$u_{j(ai)}$ = The value of the j-th criterion utility for the i-th alternative.
Example
=(0.5*1)+(0.05*1)+(0.15*1)+(0.05*1)+(0.1*1)+(0.1*1)+(0.5*1)
=0.5+0.05+0.15+0.05+0.1+0.1+0.5
=1.
The result of the calculation of the final value is sorted from the largest to the smallest value; the alternative with the most significant absolute value indicates the best choice. The result of the calculation of the final value is shown in table 7.

Table 7. Ranking table

Ranking	Alternative	
	Code	Final score
1	PL	1
2	SP1	0.5755
3	SP2	0.3955
4	SP3	0.2203
5	DO	0.1

Table 7 shows that the sanction recommendation given is "Oral Warning (PL)" because the best advice is the alternative with the highest ranking value. Alternative suggestions are shown in figure 3.

Figure 3. Alternative recommendations

After analyzing the data, the next step is to design and build a decision support system. System design starts by examining the running system. Analysis of the running system is shown in figure 4.
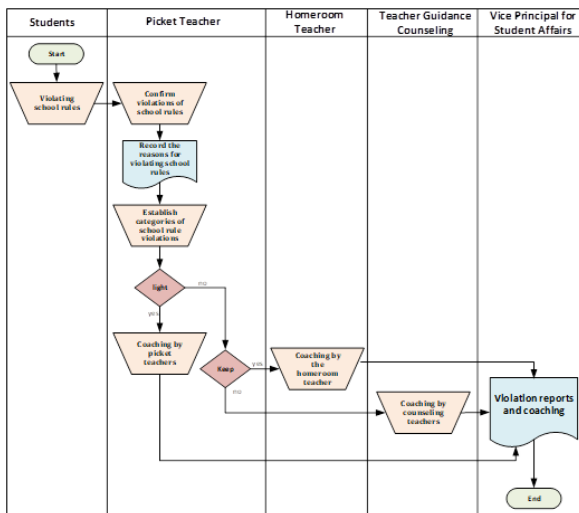
Figure 4. Existing process business

The picket teacher will record the data of the student who committed the violation and determine the point of a breach; if the end of a misdemeanour is, then the picket teacher will carry out the coaching. If the violation point is moderate, then the homeroom teacher will coach. Suppose the end of a breach is severe, then. After understanding the running process, design the system that will be developed. The system developed is a decision-supporting based system integrated with the SMART model to obtain recommendations that will be imposed on students who commit violations. The business process of the developed system is shown in figure 5.
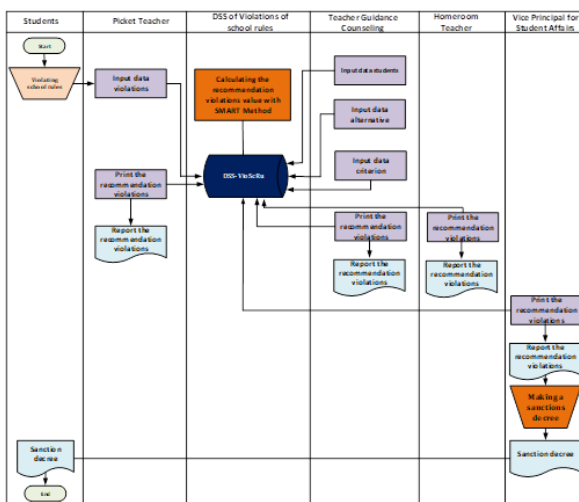

Figure 5. Developed business processes

After understanding the system model to be developed, the next step is to draw what processes actors can access, illustrated through the UML diagram. The use case diagram is shown in figure 6. There are six use cases on the system, and four actors can directly access the system.
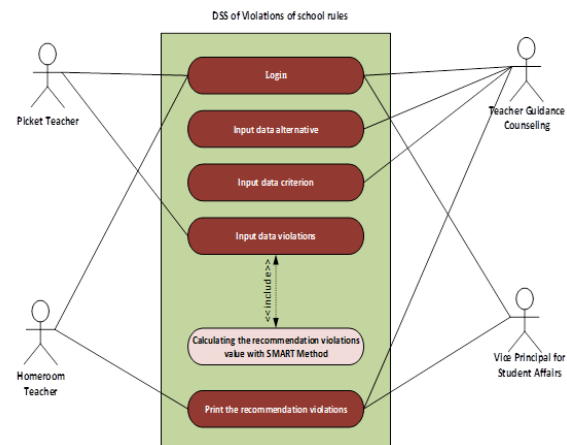

Figure 6. Use case diagram

After understanding the system model, the database needs are further designed through the UML diagram. The database is depicted through a class of graphs, shown in figure 7.

Figure 7. Class diagram

After the system design is completed, a decision support system application is built. Figure 8 shows the process of inputting data violations committed by picket teachers.

Figure 8. The process of inputting data violations

Figure 9 shows that the application of the SMART method was successfully implemented in the decision support system to inform the recommendations for appropriate sanctions for students who commit violations

Figure 9. Result of the recommendation penalty

CONCLUSION

This decision support system has succeeded in applying the SMART method. This system applies cost criteria because it is expected that students do not commit violations. This system uses four alternatives and seven groups of violation criteria. This system can shorten the discussion time between picket teachers, counselling teachers, vice class, and vice principals for student affairs in providing sanctions. The decision support system can record student violations, making it easier for stakeholders to decide the suitable sanctions.

The decision support system that has been built has not been able to provide treatment recommendations to students because this module has not yet been developed. The head decree on a

penalty given to the student cannot be printed automatically because the decree's determination is still done manually after considering the results of the system recommendations.

REFERENCE

[1] Menteri Pendidikan Dan Kebudayaan Republik Indonesia, *Peraturan Menteri Pendidikan Dan Kebudayaan Republik Indonesia Nomor 23 Tahun 2015 Tentang Penumbuhan Budi Pekerti*. Jakarta, Indonesia, 2015, pp. 1–8.

[2] A. Novitasari, "Pemberian Reward and Punishment dalam Membentuk Karakter Disiplin Anak pada Sekolah Madrasah Ibtidaiyah," *Halaqa Islam. Educ. J.*, vol. 3, no. 1, pp. 27–33, Jun. 2019.

[3] N. Hernawati, "Pengaruh Penerapan Sanksi Berjenjang Terhadap Kedisiplinan Siswa Di Sdn Mekarwangi I Kecamatan Cihurip Kabupaten Garut," *J. Pendidik. UNIGA*, vol. 2, no. 1, pp. 10–16, 2017.

[4] Ridwan, "Penerapan Hukuman Untuk Meningkatkan Kedisplinan Siswa Di Smk Negeri 1 Pangkalan Bun Kab. Kotawaringin Barat," *Angew. Chemie Int. Ed. 6(11), 951–952.*, vol. 4, no. April, pp. 5–24, 2018.

[5] K. Rinaldi, "Penerapan Sanksi Terhadap Siswa/Siswi yang Melakukan Pelanggaran di Luar Sekolah," *JURPIKAT (Jurnal Pengabdi. Kpd. Masyarakat)*, vol. 3, no. 1, pp. 84–94, Mar. 2022.

[6] R. Choirunnisa, A. Yusuf, and V. Ameliasari, "Upaya Meningkatkan Karakter Peserta Didik Melalui Kegiatan Ekstrakurikuler Kepramukaan," *J. Pendidik. Dasar J. Tunas Nusant.*, vol. 4, no. 1, pp. 458–463, 2022.

[7] S. A. Cahyono, *Peraturan Dan Tata Tertib Kehidupan Sosial Sekolah Peserta Didik SMK Gazza Wiguna 1 Megamendung*. Bogor, Indonesia, 2020, pp. 1–9.

[8] R. A. S. Prayoga and S. W. Putri, "Sistem Pendukung Keputusan Memilih Pemasok Kopi Dengan Metode Smart Pada Coffee Shop Abc Ponorogo," *J. INSTEK (Informatika Sains dan Teknol.*, vol. 7, no. 1, pp. 69–78, 2022.

[9] M. N. Amalia and M. Ary, "Sistem Pendukung Keputusan Pemilihan Supplier Dengan Menggunakan SMART Pada CV. Hamuas Mandiri," *J. Sains dan Inform.*, vol. 7, no. 2, pp. 127–134, 2021.

[10] R. S. Hayati, R. N. Sari, Hardianto, E. Syahrin, F. P. Nasution, and Daifiria, "The Implementation of Smart Method for The Selection Of Concentration Computer Engineering Courses At The University Potensi Utama," in *2019 7th International Conference on Cyber and IT Service Management (CITSM)*, 2019, pp. 1–5.

[11] A. Wahana, C. N. Alam, and S. N. Rohmah, "Implementation of the Simple Multi-Attribute Rating Technique Method (SMART) in Determining Toddler Growth," *J. Online Inform.*, vol. 5, no. 2, p. 169, Dec. 2020.

[12] N. Marpaung, A. Nata, and R. Yesputra, "Pemilihan Kain Berkualitas Dengan Metode Simple Multi Attribute Rating Technique Pada Sistem Pendukung Keputusan," *J. Sci. Soc. Res.*, vol. 5, no. 1, pp. 11–17, Feb. 2022.

[13] M. Sadly, Agustan, S. Yulianto, O. B. Bintoro, D. Sutrisno, and F. Alhasanah, "An Application of SMART Method in vendor selection of Satellite Systems Case study of Indonesia Remote Sensing Satellite Systems (InaRSSat)," in *2018 IEEE International Conference on Aerospace Electronics and Remote Sensing Technology (ICARES)*, 2018, vol. 5, pp. 1–6.

[14] L. Marlinda, Y. Durachman, E. Zuraidah, Tukino, Widivawati, and S. Hanadwiputra, "Selection of E-Marketplaces Factors Affecting Indonesian Women's Business Loyalty Using Simple Multi-Attribute Rating Technique (SMART) Method," in *2020 8th International Conference on Cyber and IT Service Management (CITSM)*, 2020, pp. 1–5.

[15] A. Tejawati, H. S. Pakpahan, and W. Susantini, "Drugs Diagnose Level using Simple Multi-Attribute Rating Technique (SMART)," in *2018 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, 2018, no. Double L, pp. 357–362.

[16] R. S. Pressman and B. R. Maxim, *Software Engineering a Practitioner's Approach*, Eighth. New York: McGraw-Hill Education, 2015.