

Application of Simple Additive Weighting (SAW) Method and Decision Table in Decision Support System Determines the Level of Problem Student Punishment Levels

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Abstract: The teaching and learning process that runs cannot be separated from the various problems of students who violate school rules. Giving punishments or sanctions to problematic students using a point system where the value of points and sanctions vary according to the type of violation. Some of the problems that arise are that the instrument is conventional, the calculation of violations is still in the form of paper based which is prone to errors (human error) and the sanctions given are sometimes due to likes and dislikes. So that the decision taken is not correct. Based on the problem, an application is made that can support decision making using the Simple Additive Weighting (SAW) method and the Decision Table. the weighting of the violation points is based on 3 (three) violations criteria, namely academic violations, aesthetic violations, and ethical violations. Each criterion will be reduced to several sub-criteria. The SAW method is a problem solving method using a weighted addition method based on certain criteria, while the Decision Table is a table that is used as a medium for solving logic in a program. In this research.

1 INTRODUCTION

Information Technology plays an important role as a medium of communication in supporting various fields of business, government, and education. Information technology can function as a media support system in decision making (Purwanto, 2018).

One of the factors that influence the comfort of teaching and learning in a school environment is problematic students who violate school rules. The role of the Guidance Counseling teacher as the front guard must be fast and responsive in dealing with problem students. Therefore, the Decision Support System (DSS) can be implemented as a decision support system in determining what actions schools must take to these students, so that the decisions made are potential and can be justified.

SMK N 1 Kawunganten is a public school located in Cilacap Regency. The number of students currently reaches \pm 1,235 students who are distributed in 35 classes in various majors. The learning process that

runs at the school certainly cannot be separated from the various problems of the students caused by the indiscipline of compliance with school rules.

Various violations that are often committed by students in schools include disciplined learning time, disrespectful attitude and harming others, fighting, smoking, consuming alcohol and drugs, watching porn videos, promiscuity, and other forms of violations. Therefore, the handling of problem students is the responsibility of all schools, both teachers and school leaders. Educational goals can be optimally achieved if the school has school rules and regulations (Utomo and Nursalim, 2019).

Policy at SMK N 1 Kawunganten in dealing with problem students using a point system. Each violation has a point value and sanctions that vary according to the type of violation. At a certain point limit, the school will determine the level and type of punishment in the form of warning letters, parent summons, suspension, and Drop Out (DO).

But now the instruments used are still conventional. Calculation of the point of violation is

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still in the form of paper based that is prone to errors (human error). Engineering punishment is very likely to occur due to factors like and dislike. Thus the decision taken becomes inappropriate. This causes frequent complaints by students and parents to the school.

Noting the problems that occur, it is necessary to make an application that can help decision making. To that end, researchers intend to create a Decision Support System to Determine the Problematic Punishment Rate for Students. Application development uses the Simple Additive Weighting (SAW) method and Decision Table. The SAW method is a method of solving problems using a weighted sum method based on certain criteria (Putra, Aryanti and Hartati, 2018), while the Decision Table is a table used as a medium for solving logic in a program so that it is effectively used when the conditions selected in the program are numerous (Kristianto, 2017).

In this study 3 (three) criteria for violations will be made, namely: Academic Violation, Aesthetic Violation, and Ethical Violation. Each criterion will be reduced to several sub criteria. For this reason, this study will use a Decision Table model that functions to identify the multilevel decisions which will then be normalized using the SAW method.

2 LITERATURE REVIEW

2.1 Related Research

Research related to the development of Decision Support System applications has been conducted by several researchers before with different methods, objects, and scope of problems.

Previous research with the title Decision Support System for Student Achievement Selection in SMK PGRI 3 Malang Using Weighted Product (WP) Method. The study was conducted with the aim of building the Achievement Student Selection Decision Support System with WP Method. The output of this system is in the form of ranking information for high achieving students based on criteria data and weight data (Faisal, 2017).

Previous research with the title Support System for Decision of Acceptance of New Students with the SAW Method at SMK Kusuma Bangsa. The parameters used are NEM, academic achievement, non-academic achievement, and test results. This decision support system is designed by ranking method using SAW by finding the weight value of each attribute, then an alternative ranking process is

carried out, namely prospective students who pass the selection (Dzulhaq, Sutarman and Wulandari, 2017).

Previous research with the title Best Student Selection Decision Support System with Analytical Hierarchy Process Method. The developed system can help objective decision making in determining the best students based on five criteria, including report card grades, attendance lists, spiritual attitudes, social attitudes, and skills (Zaki, Setiyadi and Khasanah, 2018).

Different from previous studies. In this study, researchers made DSS to determine the type and level of punishment of problem students by using the SAW method and the Decision Table. Information obtained from this system is in the form of punishment recommendations, namely verbal reprimands, written reprimands (warning letters), parent summons, suspension, and Drop Out (DO). Punishment is given based on the total score point for each type of violation committed by the student. In this study 3 (three) criteria for violations will be made, namely: Academic Violation, Aesthetic Violation, and Ethical Violation. Each criterion will be reduced to several sub criteria. For this reason, this study will use a Decision Table model that functions to identify the multilevel decisions which will then be normalized using the SAW method.

2.2 Basic Theory

2.2.1 Decision Support System

Decision Support System is part of a computer-based information system that is included in the knowledge management based system that can be used to support decision making in an organization or company (Nawir and Manda, 2018). Decision Support System is also a system that provides the ability to solve problems and communication for semi-structured problems (Sugiyarti *et al.*, 2018).

Decision making always correlates with the uncertainty of the results of decisions taken. Therefore, to reduce the uncertainty factor, the decision requires valid information about the conditions that occur, then processes the information into several alternative problem solving as consideration for deciding the steps to be carried out, so that the decision taken is expected to provide benefits (Siregar *et al.*, 2018).

2.2.2 Simple Additive Weighting (SAW) Method

SAW method is a method of solving problems known as weighting sum method based on certain criteria

(Putra, Aryanti and Hartati, 2018). The concept of the SAW method is to find the weighted sum of each alternative on all attributes(Kusumawardani *et al.*, 2019).

The SAW method only performs the normalization process by having a matrix where viewed from the columns and rows the highest value is drawn or called the maximum value and the lowest value is pulled in a row called the minimum value, normalizing the value if the value of benefits or including the criteria of benefits is done every row value divided by the highest value owned by the row, and if it is a criterion value in the form of the lowest cost value of the row divided by row value (Hutahaean and Badaruddin, 2020).

2.2.3 Decision Tables

Decision tables are tables that are used as a tool to solve logic in a program. Decision tables are also known as cause-and-effect tables that will be used to obtain decision tables (Joosten, Permanasari and Adji, 2020). Algorithms containing multilevel decisions are difficult to draw directly with pseudocode can be made in advance using the Decision Table. This method is effectively used if the conditions selected in the program are numerous(Kristianto, 2017).

2.2.4 School Rules

School rules are provisions that govern life at school and contain sanctions against violators. Violations of school rules can be grouped into four categories, namely academic violations, administrative violations, aesthetic violations, and ethical violations (Utomo and Nursalim, 2019)

3 RESEARCH METHODS

The method used in the development of the Decision Support System to determine the level of punishment of problematic students is grouped into four main components, namely research materials, research tools, research paths, and system design.

3.1 Research Materials

Research materials include:

- 1) Data obtained from analysis studies at SMK Negeri 1 Kawunganten through interviews.
- 2) Data obtained from study literature or scientific references.

- 3) Analysis of data or documents from research objects to find out how the system works to be built.
- 4) Information regarding the development of a Decision Support System that was previously carried out.

3.1.1 Research Tool

In this study, research tools are needed, namely computer devices with sufficient specifications and internet access devices.

3.1.2 Research Path

Application development in this study uses the waterfall method which consists of several phases / stages (Bassil, 2012), as shown in Figure 1.

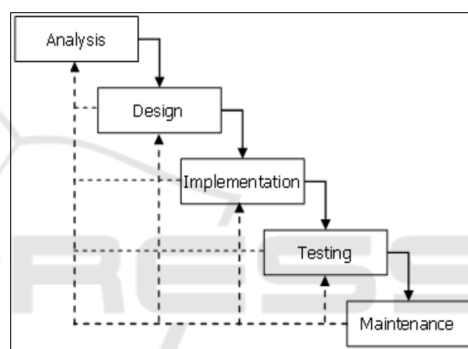


Figure 1: Waterfall Model (Bassil, 2012).

Figure 1. shows the phases / stages that can be explained as follows:

- 1) Analysis Phase

There are several analysis activities, including:

 - a. Analysis of the problem (existing condition)
 - b. Analysis of information about the types of student violations, point weight violations as well as the mechanisms and procedures for punishment of problematic student students at SMK N 1 Kawunganten. In the process of information analysis, data collection is also needed for research activities, either by interviewing or copying the data needed.
 - c. User analysis is to determine user needs.
 - d. Technology analysis is to determine the system requirements both software and hardware.
- 2) The design stage

This stage will make the design of the system design include:

 - a. Flowchart flow system,
 - b. Systems analyst modeling

- c. Relationship table
- d. Database system design
- e. Make up design (system display)
- 3) Implementation Phase
The system design that has been made will be implemented in the coding program so that a Decision Support System application is created.
- 4) Testing Phase
After the application is made the next stage is the system testing phase.
- 5) Maintenance Phase
At this stage improvements will be made if the application does not function (error).

3.1.3 System Design

The system to be developed can be shown in the flowchart as follows:

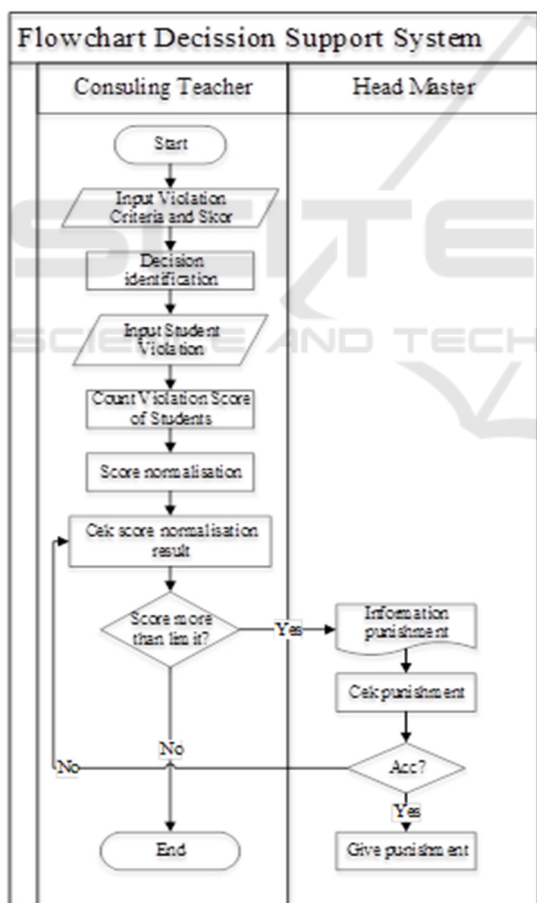


Figure 2: Flowchart System.

Figure 2 explains the flow of the decision support system that will be developed. In the figure, there are

two users who use the application, namely the counseling teacher and the head master. The counseling teacher can input the types of violations and the weight of each of these violations. Furthermore, each student's violation will be input through the application and the number of violation scores will be calculated to determine the level of punishment. If the violation score exceeds the stipulated limit, head master will give punishment in accordance with the stipulated provisions. However, if the student's violation score is less than the maximum limit, the student will not give punishment. To explain in more detail about the interaction between users and the system, a use case is made as shown in Figure 3.

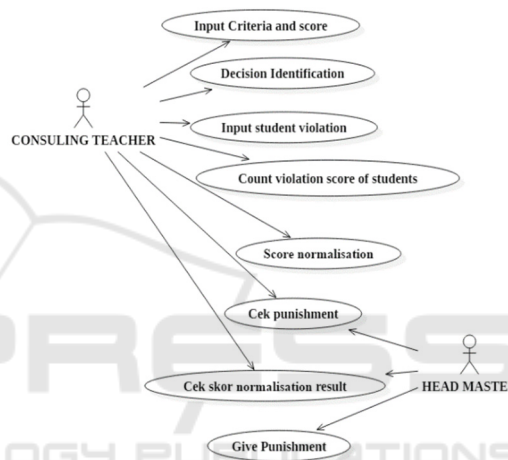


Figure 3: Use Case System.

Figure 3 describes the use case of the system to be developed. Use Case describes the interaction of actors with the existing system.

4 RESULT AND DISCUSSION

4.1 Decision Table Making

In this research discusses the level of punishment of problematic students where an assessment of violations will be carried out by students using a combination of decision tables and SAW. Punishment is given based on the total accumulated total score of each point for each type of violation committed by the student in one semester. As a first step, a decision table will be made which will be used as a tool to solve the logic in the program. In making decision tables, references and actions will be given to students if they commit violations. The

classification of violations that are often carried out by students up to the actions to be taken by the school in handling these violations can be summarized in the table below :

Table 1: Violation Points.

No.	Classification	Criteria	Point	Punishment and Action
1.	Academic Violation	Late for school	2	Reprimand and Counseling
		Not present without a certificate	5	Reprimand and Counseling
		Leave school during class time	5	Reprimand and Counseling
		Not following the flag ceremony	10	coaching and Counseling
		Activate the handphone while learning is in progress	5	Reprimand and Counseling
2.	Aesthetics Violation	Not dressed in uniform or school attributes in accordance with the provisions	2	Reprimand and Counseling
		Does not carry out cleanliness	2	Reprimand and Counseling
		Long-haired / long-haired male students or hair dyes	3	Reprimand and Counseling
		Damaging or crossing out school facilities	5	Reprimand and Counseling
		Princess students wear jewelry or dress up excessively	2	Reprimand and Counseling
		Using tattoos or body piercings that are not appropriate	50	Warning Letter II, coaching and calling parents

3.	Ethics Violation	Harrasing teacher in the school	50	Warning Letter II, coaching and calling parents
		Carrying and smoking in the school environment	15	Warning Letter I
		Drinking alcohol and drug abuse	100	Drop Out
		Committing or engaging in criminal actions against others Carry sharp weapons that can endanger and threaten the safety of others	100	Drop Out
		Students proven to steal Bringing, showing and distributing pornography	30	Warning Letter II, coaching and calling parents
		Students become pregnant or impregnate other students	80	Warning Letter I and Skorsing

Based on the table, a decision table can be made using the help of a table that contains the relationship between several attributes that affect certain attributes with the following steps:

- Determination of the conditions to be selected, in the condition of giving punishment to students who are in trouble there are 3 pieces of conditions to be selected namely:
 - Academic Violations
 - Aesthetic Violations
 - Ethics Violations
 Referrals given by the school include loud reprimands, regular reprimands, sanctions, guidance and dispensation
- Based on the number of conditions selected, it can be determined the number of possible events that occur, in this case as many as: $N = 2^3 = 8$ possible events
- Then it is formulated that there are 5 (five) actions

to be taken along with the maximum point limit:

- 1) No violation occurs if the total accumulated number of violations ≤ 10
 - 2) Warning Letter I (counseling & coaching) if the total accumulated number of violations ≤ 30
 - 3) Warning Letter II (summons of parents) if the total accumulated number of violations ≤ 50
 - 4) Warning Letter III (suspension) if total accumulated violations < 100
 - 5) Drop Out if total accumulated violations ≥ 100
4. Fill in the condition entry
 5. Fill in the action entry

Table 2: Action Entry.

Condition / Action	Rules							
	1	2	3	4	5	6	7	8
Academic Violations > maximum violations	Y	Y	Y	N	N	Y	N	N
Aesthetic Violations > maximum violations	Y	Y	N	Y	N	N	Y	N
Ethics Violations > maximum violations	Y	N	Y	Y	Y	N	N	N
No violations								X
Warning Letter I		X				X	X	
Warning Letter II				X	X			
Warning Letter III			X					
Drop Out	X							

4.2 Calculation Process in the SAW Method

After making a decision table, the next step is to perform calculations using the SAW method, where this method is known as the weighted sum method. For example here a sample of 10 students will be taken to calculate the steps as follows:

- a) There are 3 basic criteria that become a reference in making decisions, namely:
 - 1) C1 = Academic violation
 - 2) C2 = Aesthetic violation
 - 3) C3 = Ethical violation
- b) Determination of criteria weights
Weights for each criterion are: C1 = 30%, C2 = 20%, and C3 = 50%. Determination of this weight by looking at which criteria will be given a maximum and minimum value based on consideration of the existing point factors
- c) Table of alternative values of students (candidates) will be taken as a random sample 1 class of 30 people, there are :

Table 3: Value Alternative.

Alternative	Name	Criteria		
		C1	C2	C3
A1	Maulana Alif Anugerah	17	4	0
A2	Peter Sulaeman	10	9	80
A3	Nandya Saphira Esfandian	7	24	15
A4	Arya Mahardika	5	14	0
A5	Lucky Wiratama Suganda	22	53	50
A6	Gracia Vini	12	7	0
A7	Ckasinta Winda Santi	27	22	30
A8	Yolanda Novitra Setiawan	2	8	50
A9	Hazana Delfani	30	7	15
A10	Rosyanda Sastie Lagattri	15	17	18
A11	Afinda Andi Prayugo	10	2	0
A12	Akhmad Rofiq Mustofa	15	4	0
A13	Azis Satria Putra	2	5	15
A14	Cahya Romadhon	5	7	15
A15	Dendi Fajar Efendi	2	2	0
A16	Farid Al A'rof	2	9	0
A17	Azka Raihan Tahta Aunillah	2	10	0
A18	Bara Bima Hestyta	17	15	0
A19	Dafi' Al Khayyan	5	5	15
A20	Juan Dwi Bhakti Nugroho	5	5	15
A21	Aan Wili Krisyanto	15	10	0
A22	Abdul Khalim	20	17	0
A23	Achmad Fuady	25	12	0
A24	Andi Wahyu Perdana	5	4	0
A25	Atha Syarif Priyanto	5	4	0
A26	Bagas Artha Jati	25	22	15
A27	Bagas Prayogo	0	7	0
A28	Banu Muarif	2	9	0
A29	Bayu Mangun Kusumo	2	12	0
A30	Beni Setiawan	12	12	0

- d) Determine the value of each weight

Table 4: Weighted Value.

Total points of violation	The weight value is based on the total number of subscribers of the total violation points
0 – 20	1
21 – 45	2
46 – 75	3
76 – 99	4
>100	5

- e) Based on the data suitability value between the

alternatives with the criteria in the table above, and with the weight of the existing values, a decision matrix (X) can be made and a normalization calculation is carried out to obtain a normalized value matrix of each existing value. The values are shown in tabular form as follows:

Table 5: Normalization Calculation.

Alternative	Decision matrix value			Normalized value matrix		
	C1	C2	C3	C1	C2	C3
A1	1	1	1	0,5	1	0,25
A2	1	1	4	0,5	1	1
A3	1	2	1	0,5	0,5	0,25
A4	1	1	1	0,5	1	0,25
A5	2	3	3	1	0,33	0,75
A6	1	1	1	0,5	1	0,25
A7	2	2	2	1	0,5	0,5
A8	1	1	3	0,5	1	0,75
A9	2	1	1	1	1	0,25
A10	1	1	1	0,5	1	0,25
A11	1	1	1	0,5	1	0,25
A12	1	1	1	0,5	1	0,25
A13	1	1	1	0,5	1	0,25
A14	1	1	1	0,5	1	0,25
A15	1	1	1	0,5	1	0,25
A16	1	1	1	0,5	1	0,25
A17	1	1	1	0,5	1	0,25
A18	1	1	1	0,5	1	0,25
A19	1	1	1	0,5	1	0,25
A20	1	1	1	0,5	1	0,25
A21	1	1	1	0,5	1	0,25
A22	1	1	1	0,5	1	0,25
A23	2	1	1	1	1	0,25
A24	1	1	1	0,5	1	0,25
A25	1	1	1	0,5	1	0,25
A26	2	2	1	1	0,5	0,25
A27	1	1	1	0,5	1	0,25
A28	1	1	1	0,5	1	0,25
A29	1	1	1	0,5	1	0,25
A30	1	1	1	0,5	1	0,25

f) To simplify the action to be performed, a range of values is determined from the sum of each criteria.

Table 6: Range of Criteria.

Action	Value Range
No Violation	0 - 0,59
Warning Letter I	0,60 - 0,72
Warning Letter II	0,73 - 0,84
Warning Letter III	0,85 - 0,97
Drop Out	>=0,98

g) The last is calculating the value of preference weights for each alternative, accompanied by a reference to the action to be taken.

In the system developed, the process of calculating the violation score of each student can be shown in Figure 4.

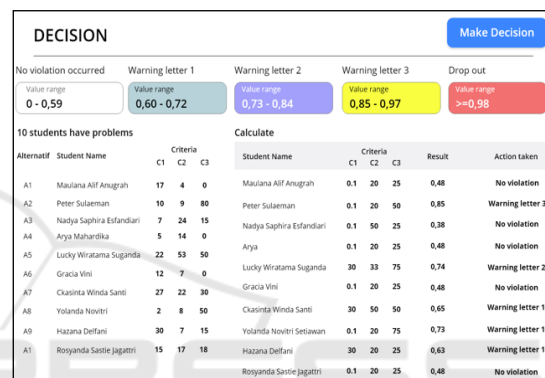


Figure 4: Calculation of student violation and action.

Figure 4, shows the calculation of the score of violations committed by each student. In the picture, the scores of each score are seen and show the actions given to the problematic students.

The detailed calculation of each student's violation score is shown in Figure 5.

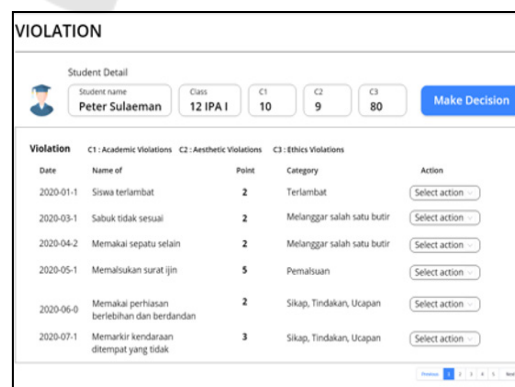


Figure 5: Calculation of details each student violation score.

Figure 5, shows the calculation of the violation score of each student in detail.

Table 7: Final Calculation aPnd Action.

Alter native	Criteria			Total of each criteria	Action
	C1	C2	C3		
A1	0,15	0,20	0,13	0,48	No Violation
A2	0,15	0,20	0,50	0,85	Warning Letter III
A3	0,15	0,10	0,13	0,38	No Violation
A4	0,15	0,20	0,13	0,48	No Violation
A5	0,30	0,07	0,38	0,74	Warning Letter II
A6	0,15	0,20	0,13	0,48	No Violation
A7	0,30	0,10	0,25	0,65	Warning Letter I
A8	0,15	0,20	0,38	0,73	Warning Letter I
A9	0,30	0,20	0,13	0,63	Warning Letter I
A10	0,15	0,20	0,13	0,48	No Violation
A11	0,15	0,20	0,13	0,48	No Violation
A12	0,15	0,20	0,13	0,48	No Violation
A13	0,15	0,20	0,13	0,48	No Violation
A14	0,15	0,20	0,13	0,48	No Violation
A15	0,15	0,20	0,13	0,48	No Violation
A16	0,15	0,20	0,13	0,48	No Violation
A17	0,15	0,20	0,13	0,48	No Violation
A18	0,15	0,20	0,13	0,48	No Violation
A19	0,15	0,20	0,13	0,48	No Violation
A20	0,15	0,20	0,13	0,48	No Violation
A21	0,15	0,20	0,13	0,48	No Violation
A22	0,15	0,20	0,13	0,48	No Violation
A23	0,30	0,20	0,13	0,63	Warning Letter I
A24	0,15	0,20	0,13	0,48	No Violation
A25	0,15	0,20	0,13	0,48	No Violation
A26	0,30	0,10	0,13	0,53	No Violation
A27	0,15	0,20	0,13	0,48	No Violation

A28	0,15	0,20	0,13	0,48	No Violation
A29	0,15	0,20	0,13	0,48	No Violation
A30	0,15	0,20	0,13	0,48	No Violation

4.3 System Testing

System testing is done by white box testing method. Tests carried out by 10 respondents with results as shown in Table 8.

Table 8: System Testing.

No.	Assessment	Test Result		
		NA	A	SA
1.	Calculation of point weight scores for each type of violation becomes more precise and accurate	0	3	7
2.	Can reduce the risk of miscalculation and rakapitulation points violations caused by human error	0	2	8
3.	Can avoid the existence of engineering punishment caused by like and dislike factors	0	2	8
4.	The validity of the level of punishment or sanctions information that will be given problematic students are more guaranteed and in accordance with the type violations committed (accurate)	0	5	5
5.	Can help the school (elements of the school leadership) in making the right decision and can be accounted for	0	4	6
Amount		0	16	34
Percentage (%)		0	32	68

Notes :

NA = Not Agree

A = Agree

SA = Strongly Agree

Table 8, shows the results of the system testing conducted by 10 respondents. Based on the results of testing that has been done, in general the system can assist leaders in making decisions against students who have problems and provide penalties in accordance with the violations that have been committed.

5 CONCLUSION

Based on research that has been done by developing a decision support system to determine the punishment of problem students using the decision table and the SAW method and testing the system with 10 respondents, the results show 68% of respondents strongly agree that with the decision support system, the calculation of point weight scores from each type of violation to be more precisely and accurately, the risk of miscalculation and rakapitulation points violations caused by human error can be minimized, punitive engineering caused by like and dislike factors can be avoided, the validity of the level of punishment or sanctions that will be given problematic students are more guaranteed and in accordance with the type violations committed, school leaders can make the right decisions and can be accounted for.

Suggestions that can be made for the development of the system in further research is the need to develop an sms gateway function that can provide information on student violations automatically to parents of guardians and actions taken by the school against students with problems. Thus, guardian parents can find out information on violations committed by their children.

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