

Decision Support System for Election of OSIS Chair for Muhammadiyah Schools Using the Simple Multi Attribute Rating Technique Exploiting Rank (SMARTER) Method

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Abstract. OSIS (Organisasi Intra Sekolah) is an official Student Council, which found in every school in Indonesia. The problem to be solved in a school is the need for an OSIS as a forum for students in schools to achieve the goals of coaching and developing students in accordance with the school's vision and mission. The main task of OSIS task is to achieve the goals in accordance with the school's vision and mission, therefore OSIS chair should have competencies and skills. The right decisions are needed for the implementation of the school's vision and mission. This first stage of research is performed by doing interview and survey to determine the criteria of OSIS chair. Based on interview and questionnaire has indicate that the student council member elects the chair based on several criteria consist of managerial ability, responsibility, communication and cooperation as well as discipline. The method proposed in the selection of the OSIS chairperson using simple multi attribute rating technique exploiting rank (SMARTER) approach and using Rank Order Centroid (ROC) weighting. The result of this study indicates that 75% of OSIS coaches and members need a decision-making system that can assist OSIS in making computerized decisions in determining the next OSIS chair candidate.

Keyword: SMARTER, ROC, Decision-making system, Student council president

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1 Introduction

The ability to make quick and accurate decisions will be key success in competition and make decisions. However, make decisions need considering the criteria that influence the

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problems require a decision. Making a decision with several criteria requires a technique when decision-making criteria are interrelated. To make it visible, we need a calculation to make decision better, quick, and accurate. As the number of students increases which influence in student diversity. Many students have priorities criteria in electing the student council chair candidate [1].

The election of the candidate for the OSIS chair is performed based on several assessment factors such as managerial ability, responsibility, communication and cooperation, and discipline. At this time, the election process for the candidate for OSIS chair is still going through the voting system. Even, voting system results is still not accurate. Therefore, it is necessary to have a decision support system for the selection of the OSIS chair candidate that can assist the teacher council in selecting the next OSIS chair candidate that have accurate calculations [2]. The Simple Multi Attribute Rating Technique Exploiting Ranks (SMARTER) method is a multi-criteria decision-making method with values and weights of importance between one criterion and another. The advantage of this method is suitable in decision making process with come criteria. In previous research, regarding the choice of generation technology namely the technology management model conditioned by reducing CO₂ emissions in the power system. Decision-making regarding the management of change in power generation units (construction of new units, modernization of existing ones, decommissioning of inefficient ones) is a multi-criteria issue. The single criterion analyzed is no longer an efficient approach. Therefore, in supporting decision makers by applying the approach of regional MCDM (multi-criteria decision making) [3].

In this research to select the student council president candidate, the system will use the Simple Multi Attribute Rating Technique Exploiting Ranks (SMARTER) method. The SMARTER method is a multi-criteria decision-making method proposed by Edwards and Baron in 1944. This multi-criteria decision-making technique is based on the theory that each alternative consists of a number of criteria that have values and each criterion has a weight that describes how important it is compared with other criteria [4]. With the ROC (Rank Order Centroid) technique, ROC can carry out the process of weighting criteria so that the distance between criteria can be maintained. In a previous study regarding the Analytical Hierarchy Process Method for Voting for the Web-Based OSIS Chairperson Election. In this study, in improving the decision to select the Student Council Chair with the Analytical Hierarchy Process Method which must be started again from the initial stage, while the Simple Multi Attribute Rating Technique Exploiting Ranks (SMARTER) method does not require an early stage again because each alternative consists of a number of criteria that have different criteria. value and each criterion has a weight that describes how important it is compared to other criteria. The AHP method is only a mathematical method without using quantitative testing so that there is no confidence limit for the correctness of the model formed, while the Simple Multi Attribute Rating Technique Exploiting Ranks (SMARTER)

method has a better alternative performance measure than other methods because the analysis combines various kinds of performance. quantitative and qualitative criteria[5].

2. Literature Study

2.1. The Official Student Council (OSIS)

OSIS is an organization that is at the school level in Indonesia starting from Junior High School (SMP) and Senior High School (SMA). OSIS comprises student members who have competence in the division and teacher as supervisor. All OSIS members have the right to choose their candidate to become the OSIS board [5]. The Directorate of Primary and Secondary Education stated that OSIS has three main functions, as described:

1. OSIS as a medium for students to knowledge and experience sharing, support student activities either academic or extracurricular purposes.
2. OSIS as motivator means to make student enthusiasm to act and carry out activities together in achieving goals.
3. OSIS as student guidance means develop the student characteristic and good personality, skills such as leadership, integration, loyalty etc. which able to participate in their environment to follow school activities and social activities from outside environment [6].

2.2. Decision Support System

The decision-making system or also known as decision support system (DSS) is activity to help managers make decisions. The function of DSS is not to evaluate and replace role of managers. DSS is a computer assisted system intended to assist decision makers in utilizing data and models to solve various semi-structured and unstructured problems[6]. The concept of DSS was first introduced in the early 1970s by Michael S. Scott Morton with the term Management Decision Systems [5]. DSS have main objectives as follows:

1. Assist managers in making decisions on semi-structured problems.
2. Provide support at the manager's discretion and not to replace the manager's function.
3. Increasing the effectiveness of decisions taken by managers more than improving their efficiency.
4. Computing speed. Computers allow decision makers to do a lot of computing quickly at low cost.
5. Quality support. Computers can improve the quality of decisions made, for example: the more data that is accessed, the more alternatives that can be evaluated.
6. Overcome cognitive limitations in processing and storage.

2.3. SMARTER Method (Simple Multi Attribute Rating Technique Exploiting Rank)

SMARTER method is a development of the previous method, the Simple Multi-Attribute Rating Technique (SMART) method. Method (SMARTER) Is a multi-criteria decision-making method proposed by Edwards and Baron in 1994. The multi-criteria decision-making technique is based on the theory that each alternative consists of a number of criteria that have values and each criterion has a weight that describes how important it is compared with other criteria. The weighting of the SMARTER method uses a range from 0 to 1, making it easier to calculate and compare values for each alternative. Since its inception, the SMART method has been developed into the Simple Multi-Attribute Rating Technique Swing (SMARTS) method and after being modified and improved by Edward and Baron in 1994 it became the SMART method [4]

2.4. ROC (Rank Order Centorid) Weighting

The ROC weighting technique is based on the level of importance or priority of the criteria. According to the cited journal [4], the ROC technique gives weight to each criterion according to the ranking that is assessed based on the priority level. Usually formed with the statement "Criterion 1 is more important than criterion 2, which is more important than criterion 3" and so on until the nth criterion, written $CR_1 \geq CR_2 \geq CR_3 \geq \dots \geq CR_n$. To determine the weight, the same rule is given, namely $W_1 \geq W_2 \geq W_3 \geq \dots \geq W_n$ where W_1 is the weight for criterion C_1 or it can be explained as follows:

If:

$$CR_1 \geq CR_2 \geq CR_3 \geq \dots \geq CR_n$$

So:

$$W_1 \geq W_2 \geq W_3 \geq \dots \geq W_n$$

Furthermore, if k is the number of criteria, then:

$$W_1 = \frac{(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{k})}{k} \quad (1)$$

$$W_2 = \frac{(0 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{k})}{k} \quad (2)$$

$$W_3 = \frac{(0 + 0 + \frac{1}{3} + \dots + \frac{1}{k})}{k} \quad (3)$$

$$W_k = \frac{(0 + \dots + 0 + \frac{1}{k})}{k} \quad (4)$$

In general, the ROC weighting can be formulated as follows:

$$W_k = \frac{1}{k} \sum_{i=0}^k \left(\frac{1}{i} \right) \quad (5)$$

3. Research Method

In this research we used the Rapid Application Development (RAD) method. This method aims to shorten the time and cost in system development. Rapid Application Development (RAD) is a linear sequential software development process that emphasizes a short development cycle and iterative to determine user requirements and subsequently removed [7]. The process of RAD includes requirements planning, system design, and implementation [8]. At the requirements planning stage, the developer determines data used, namely criteria data in designing of a decision support system for the selection of the OSIS chairman by using SMARTER method, as well as the data requirements needed in the implementation of the system [4]. At the system design stage, the developer analyzes and designs the system that will be used at the implementation stage. The method is depicted as Figure 1.

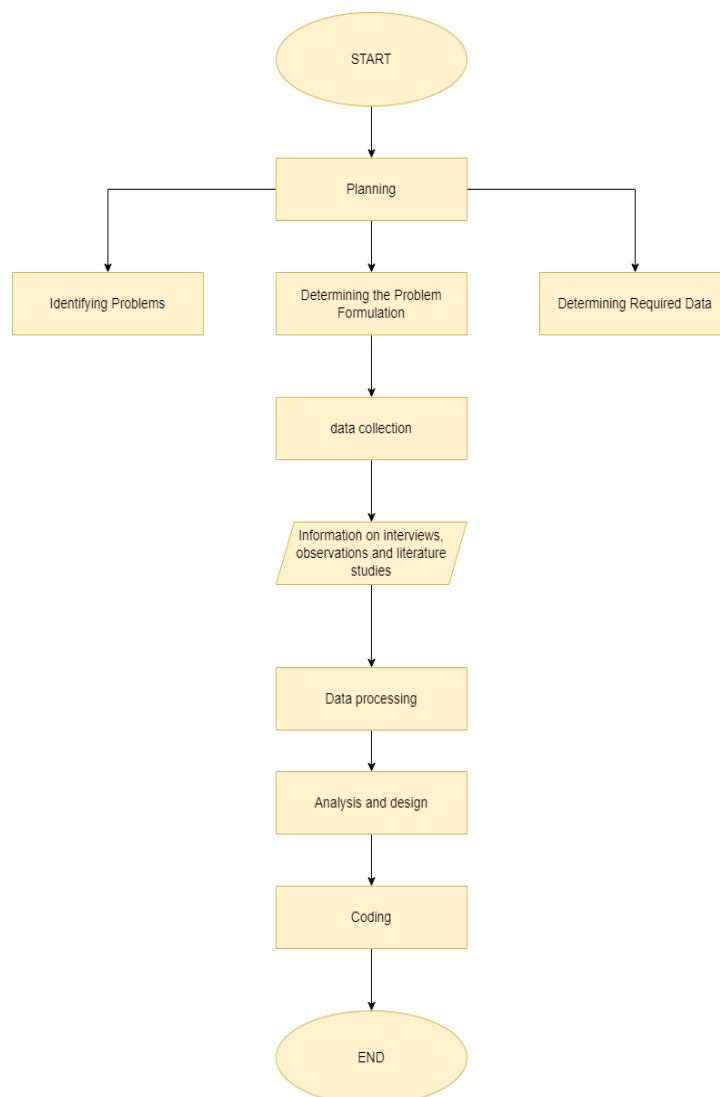


Figure 1. Research Methodology

4. Results and Discussion

4.1. Data Collection

First, developer should identify user need. To gather user need, we provide two types namely interview and survey questionnaires. Respondents of interview are student council supervisor, whereas survey are student. Some item interview and survey questionnaire as described below:

a. Interview Questionnaire

1. How to determine the candidate for OSIS chair?
2. What considerations are the benchmarks for the assessment?
3. What considerations are most important if they can be sorted?
4. Do you think the determination is effective?

If not, what are the obstacles that make it ineffective?

b. Survey Questionnaire

1. I feel it takes a long time to find out the results of the interview.
2. I find it difficult to obtain information from interviews.
3. I feel that there has been fraud in determining the candidate for the OSIS chairman.
4. I feel that the procedure for selecting a candidate for chairman is ineffective.
5. I feel that technology is needed to determine the candidate for OSIS chairman.

Based on the results of the interviews, it can be concluded that:

1. The coach and student council members faced difficulty in choosing student council chair.
2. The results of OSIS chairman election are still subjective because uses a voting system whose selection standards are based on special criteria.
3. The assessment factors for the selection of the OSIS chairperson consist of managerial ability, knowledge and skills, responsibility, communication and cooperation as well as discipline.

The questionnaire result from 20 respondents has shown as Table 1.

Table 1. Questionnaire Result

No	Question	Answer		
		Agree	Normal	Dissagree
1	I feel it took a long time to find out the results of the interview.	60,00 %	25,00 %	15,00 %
2	I find it difficult to obtain information on interview results	15,00 %	25,00 %	60,00 %
3	I feel that there has been a fraud in the selection of the candidate for the OSIS chairman.	40,00 %	35,00%	25,00 %

4	I feel that the procedure for selecting a candidate for chairman is ineffective.	5,00 %	25,00 %	70,00 %
5	I feel that technology is needed to determine the candidate for student council president.	75,00 %	10,00 %	15,00 %

The result survey that respondents strongly agree that the previous election system for the candidate for the OSIS chair is not effective and requires technology to determine it.

4.2. Needs Plan

4.2.1. Formulate of Problem

The system that was built was the SPK to select the candidate for the student council chair

4.2.2. Data collection

After performing interview and survey, we obtained functional and non-functional requirements to develop OSIS chairman election system as describe as follows:

a. Functional Requirements

1. The system can input candidate and admin data.
2. The system can store the candidate data for the OSIS chairperson and the admin (Advisor).
3. The system can store the criteria and sub-criteria values.
4. Only the admin can input the interviewer's criteria value.
5. The system can calculate the total value of the interview results for the candidate for the OSIS chairman.
6. The system can sort the results in descending order.
7. The system can display the sorting results.
8. The system can determine who passes and does not pass the interview to the OSIS chairman candidate.
9. The system can display the value of each candidate only to the admin.
10. The system has optimal security.

b. Non-functional requirements

1. The system requires an android smartphone with a minimum version of Lollipop.
2. The system requires a maximum memory storage of 50 MB.
3. The system must be able to ensure that the data used in the system must be protected from unauthorized access.
4. The system must be able to provide restrictions on user access to the features provided.
5. Users and admins need internet to access the application.
6. Users need to download the application first so that it can be accessed.
7. The system requires a database to store data and results.

8. The system has a user-friendly and interactive interface.
9. The process from the user to see the selection results does not take more than 10 seconds

4.3. System Design Process

4.3.1. SMARTER ROC Method Analysis

a. Determining Criteria

Based on interview with the OSIS supervisor, we found that there are several criteria in election of The OSIS chairman. The criteria are ordered based on the agreement of the student council supervisor as shown in Table 2.

Table 2. Criteria of Decision Making

No.	Criteria	Ranking
1	Managerial Ability	1
2	Responsibility	2
3	Discipline	3
4	Communication and Cooperation	4

b. Determining the Criteria Weight Value

Each of criteria has the weight value which determined by its priority based on the calculation of ROC (Rank Order Centroid) as shown as Table 3.

Table 3. Weight Value of Criteria

No.	Criteria	Weight Value
1	Managerial Ability	0,52
2	Responsibility	0,27
3	Discipline	0,15
4	Communication and Cooperation	0,06

c. Determining the Sub-Criteria Weight Value

The application of the quiz system is an effective way to avoid subjectivity when determining the candidate for OSIS chairman. The quizzes are multiple choice have answer to maximize the level of objectivity. Each choice has a level which create weight value of sub-criteria using ROC (Rank Order Centroid).

Table 4. Weight Value of Sub-Criteria

No.	Criteria	Sub – Criteria	Rank	Weight with ROC
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1	Managerial Ability	Very good	1	0,45
		Well	2	0,26
		Enough	3	0,16
		Not good	4	0,09
		Very Bad	5	0,04
2	Responsibility	Very good	1	0,45
		Well	2	0,26
		Enough	3	0,16
		Not good	4	0,09
		Very Bad	5	0,04
3	Discipline	Very good	1	0,45
		Well	2	0,26
		Enough	3	0,16
		Not good	4	0,09
		Very Bad	5	0,04
4	Communication and Cooperation	Very good	1	0,45
		Well	2	0,26
		Enough	3	0,16
		Not good	4	0,09
		Very Bad	5	0,04

d. Determining the Final Result

The final result is obtained by multiplying the criteria and sub-criteria values. From these results, a ranking will be obtained that can be used as a decision maker for the election of the OSIS chairman candidate.

$$Result = \sum (Criteria * sub criteria) \quad (6)$$

e. Application of the SMARTER Method

After obtaining the ROC value, it will be transformed to an alternative value and perform the process of searching by multiplying the alternative weighting value of criteria. The calculation of utility value is obtained from the result of quiz which consisting of 10 questions comprising two questions in each criterion. The result obtained as shown as Table 5.

Table 5. Table of Question Criteria

No.	Criteria-Sub Criteria	Answer 1	Answer 2
1	Managerial Ability	2	1
	Responsibility	3	4
	Discipline	1	1
	Communication and Cooperation	2	3
2	Managerial Ability	4	5
	Responsibility	1	3
	Discipline	3	2
	Communication and Cooperation	1	1
3	Managerial Ability	1	4
	Responsibility	3	2
	Discipline	1	2
	Communication and cooperation	3	2

Description : 1-Very good, 2-Well, 3-Enough, 4-Not good, 5-Very bad

The calculation produced score for each answer of criteria as shown as Table 6 and Table 7.

Table 6. Score Each Answer

No	Question Criteria	Answer 1	Answer 2
1	Managerial Ability	0,1352	0,234
	Responsibility	0,0432	0,0243
	Discipline	0,0675	0,0675
	Communication and Cooperation	0,0156	0,0096
2	Managerial Ability	0,0468	0,0208
	Responsibility	0,1215	0,0432
	Discipline	0,024	0,039
	Communication and Cooperation	0,027	0,027
3	Managerial Ability	0,234	0,0468
	Responsibility	0,0432	0,0702
	Discipline	0,0675	0,039
	Communication and Cooperation	0,0096	0,0156

Table 7. Results Based on Criteria

No	Question Criteria	Score
1	Managerial Ability	0,3692
	Responsibility	0,0675
	Discipline	0,135
	Communication and Cooperation	0,0252
2	Managerial Ability	0,0676
	Responsibility	0,1647
	Discipline	0,063
	Communication and Cooperation	0,054
3	Managerial Ability	0,2808
	Responsibility	0,1134
	Discipline	0,1065
	Communication and Cooperation	0,0252

Based on the agreement of the OSIS supervisor from the results of the election of the OSIS chairman candidate, there are 2 top candidates who can qualify as a candidate for the OSIS chairman. Table 8 shows the ranking process from three candidates.

Table 8. The final result

A	Final Score	Ranking
1	0,5969	1
2	0,3493	3
3	0,5259	2

4.3.2. System Design

a. ERD (Entity Relationship Diagram)

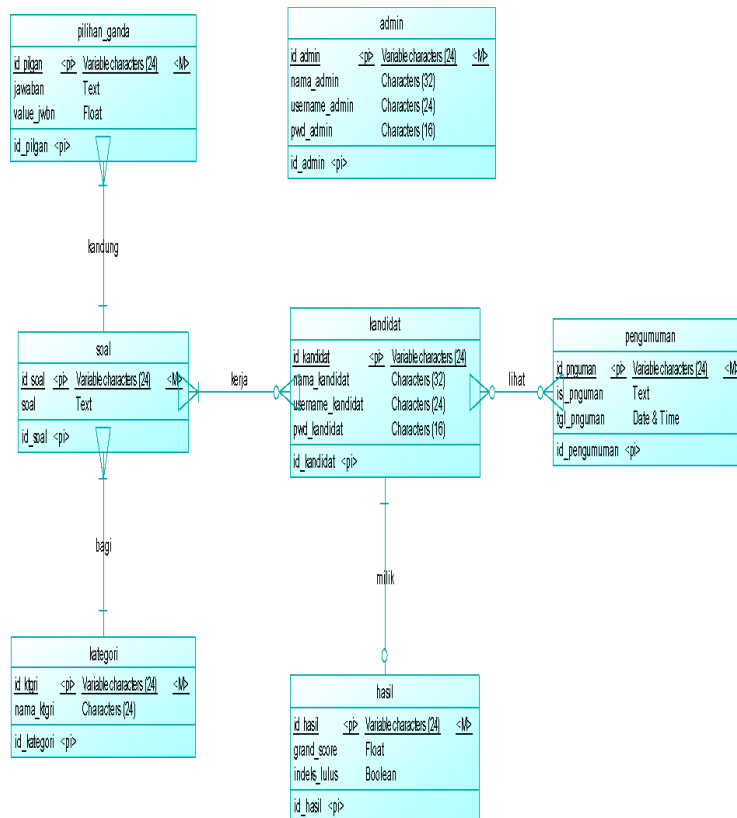


Figure 2. Entity Relationship Diagram of System

b. Use Case Diagrams

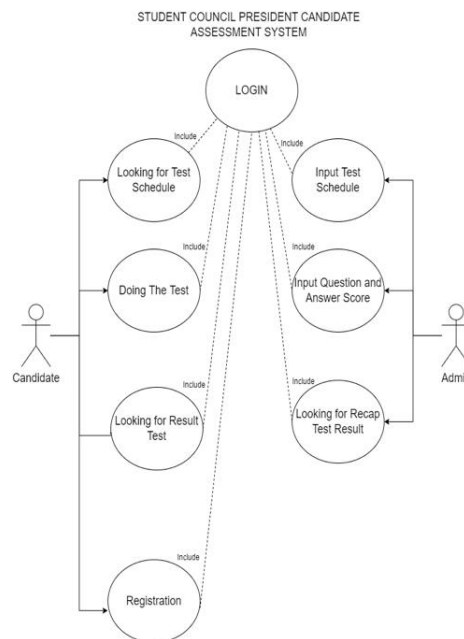


Figure 3. Use Case Diagram of System

d. Activity Diagram

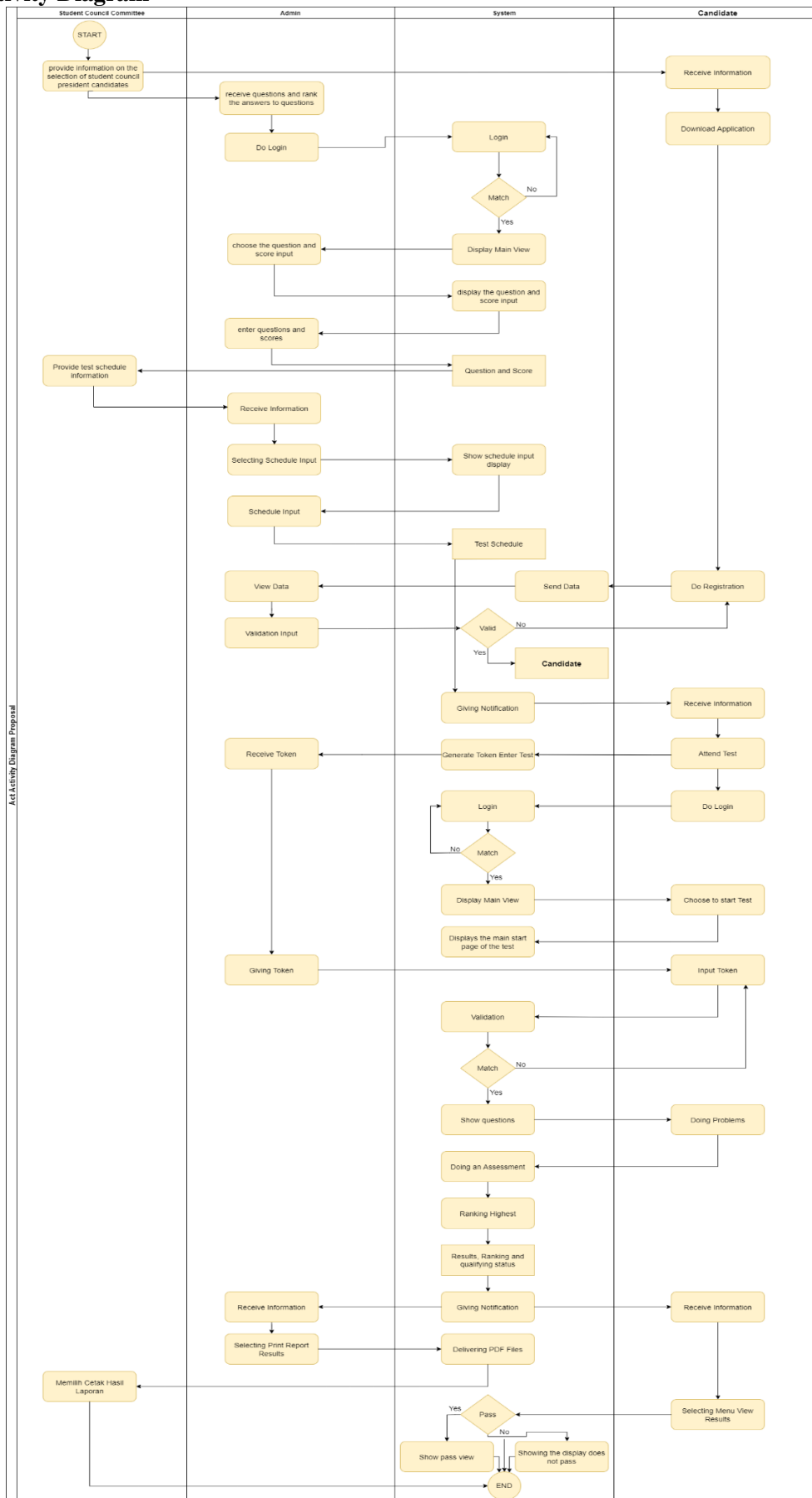


Figure 5. Activity Diagram of System

e. User Interface Design

In this phase, DSS was developed should build user interface to make action easily to observe the election of OSIS chair. Some layouts of user interface as shown as Figure 6, 7, 8, 9, and 10.

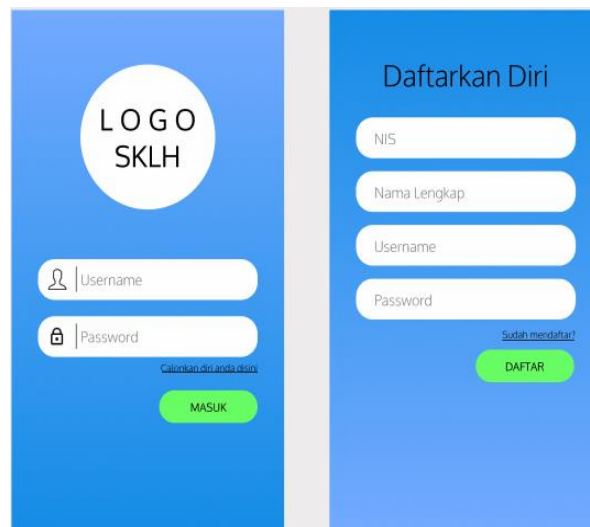


Figure 6. Display Login and Register



Figure 7. Admin Main Display (Left) and Candidate (Right)

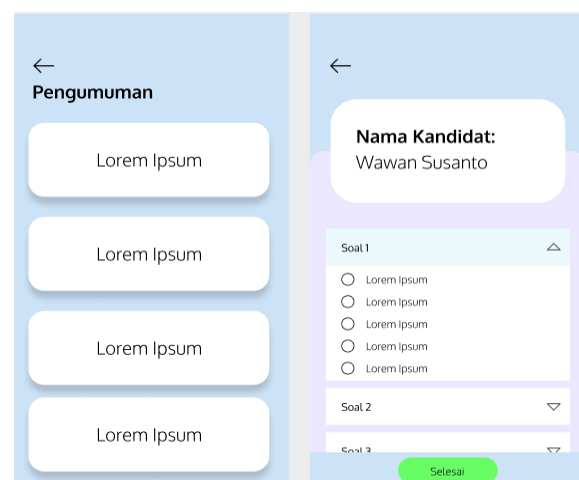


Figure 8. Display of Viewing Announcements Doing Tests



Figure 9. Display Viewing Test Results

No	Nama Kandidat	Nilai
1	Lorem Ipsum	0.1123
2	Lorem Ipsum	0.1123
3	Lorem Ipsum	0.1123
4	Lorem Ipsum	0.1123
5	Lorem Ipsum	0.1123
6	Lorem Ipsum	0.1123

Figure 10. Display of Candidate Score Recapitulation

5. Conclusion

Based on the results of the analysis and design of a decision support system for the selection of the candidate for OSIS chairperson with the implementation of SMARTER at Muhammadiyah schools, it can be concluded that the decision support system built can produce a sequence of values from the largest to the smallest candidate scores obtained by the SMARTER method, so that it can assist the teacher council in making decisions effectively. permanently computerized. And it is hoped that the computerized calculations can reduce subjectivity in determining the candidate for the student council chairperson for Muhammadiyah school. The system is built using Kotlin and uses MySQL-based database storage.

However, the method that has been used also has limitations, namely this method ignores the reciprocal relationship between parameters and the ranking of alternatives is not relative, changing the number of alternatives is considered not to automatically change the decision value of the original alternative, then another limitation is that many attributes will make the SMART method too difficult to implement and maintain. Therefore, a support system with higher

performance is needed in order to reduce subjectivity to determine the candidate for the OSIS chairperson at school[3]

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