METHODS COMPARISON OF ARAS AND TOPSIS FOR DETERMINING THE BEST PRACTICUM ASSISTANT (CASE STUDY CHEMICAL LABORATORY DEPARTMENT OF FMIPA UHO)

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ABSTRACT

Practicum is one of the activities that are part of the curriculum in universities. The role of a practicum assistant is needed to support practicum activities. Practicum assistants is a selected through a selection process. The selection of practicum assistants at the Faculty of Mathematics dan Natural Science (FMIPA), Halu Oleo University, to be precise the department of Chemistry, is still done through a manual process. The problem faced in the selection process is that each lecturer determines the ranks of the selected practicum assistants sequentially, from the first practicum supervisor lecturer to the last, which takes a long time and subjective assessment is unavoidable. Then from that problem, it is necessary to develop a computerized system as a supporting media in decision-making to facilitate selecting practicum assistants. The Additive Ratio Assessment (ARAS) and Technique For Others Reference By Similarity To Ideal Solution (TOPSIS) method applicated to compare the results of the two ways. The results of the comparison of the two methods show that TOPSIS provides a higher accuracy value of 50%, while the accuracy value of the ARAS method is 44%, but from testing the speed of processing data, the ARAS method is faster than the TOPSIS method.

Keywords: *Decision support system, ARAS method, TOPSIS method*

I. INTRODUCTION

Practicum is one of the activities that are part of the curriculum in universities. The role of a practicum assistant does need in every practical implementation in the laboratory. The practicum assistant is an active student in the ongoing semester as an academic administrator. A practicum assistant has been selected at the selection stage as a teaching assistant in practicum activities.

The Selection of practicum assistance at the Faculty of Mathematics and Natural Sciences, Halu Oleo University in the Department of Chemistry, is carried out every odd and even semester. Based on the result of an interview with the head of the chemistry department laboratory. That there are 7 practicum courses for odd semesters and 4 practicum courses for even semesters. Students who register to become practicum assistants with approximately 40 names for each practicum, with a quota of 10 people who will be accepted for each practicum course. Students may apply for more than one practicum course.

The implementation selection of practicum assistants is still carried out through a manual process. The selection of practicum assistants is carried out through a meeting led by the head of the laboratory and all lecturers who teach practicum courses. The problem with the selection process is each lecturer sorts the selected names of practicum assistants alternately which takes a long time more than 2-3 hours so that subjective assessment cannot be avoided. The COVID-19 pandemic also affected the selection process, where the selection process was carried out through a WhatsApp group meeting which took longer than usual conditions. Based on the problems that have been explained, it is necessary to develop a computerized system as a supporting medium in helping to facilitate the process of selecting practicum assistants. Therefore, it is necessary to develop a computerized system based on the internet network.

A Decision Support System (DSS) is one solution as a supporting system that can provide problem-solving or communication for various conditional problems of unstructured and semi-structured[1]. The Decision Support System (DSS) has one goal, namely providing information, guidelines, and forecasts for information users to facilitate the best decision making.

ARAS method is one of the methods in making the latest multi-criteria decision according to the concept of rating that utilizes utility degree to find out the comparison between the overall index value of each alternative with the overall index value of the optimal alternative[2]. The priority of alternatives is determined according to the value of the utility function, so it can be easier to evaluate and rank decision alternatives when using this method[3]. Although included in the newly developed method, the ARAS method is efficient and able to solve multi-criteria problems[4].

Technic for Order Preference by Similarity to Ideal Solution (TOPSIS) is also one of the methods of multicriteria analysis in determining decisions based on existing alternatives. TOPSIS was first invented in 1981 by Yonn and Hwang[5]. The TOPSIS method considers all solutions categorized as positive ideals and negative ideals. A positive ideal solution is the best value of any attribute that can be achieved, while negative solutions are the worst value of each attribute[6]. The TOPSIS method has been applied to problems because has several advantages. The advantage of TOPSIS is the simple concept of TOPSIS can provide convenience for its users, which has an efficient calculation concept and can calculate the relative performance of each alternative decision with a simple mathematical model[7].

II. RESEARCH METHOD

A. Decision Support Systems

DSS is a computerized system that supports stakeholders in making decisions as a supporting means of improving skills to make decisions, but not replacing the value that has been given by stakeholders.DSS can be used for decisions that require the provision of values based on the level of importance or for decisions that cannot be solved by using algorithms [8].

B. Metode Additive Ratio Assessment (ARAS)

The ARAS method is a method used in determining the ranking according to the established criteria of the utility degree, where it will be compared to all index values of each alternative to all index values from the optimal alternative. In 2010 ARAS was first introduced by Turkis and Zavadskas from Vilvinus Gediminas Technical University. ARAS refers to the opinion that complex problems can be easily analyzed and concluded using relative comparisons[9].

The process determine decision rank using the ARAS method consists of five steps as follows:

1. Decision Matrix Formation

Alternatively, 0 or A0 on the decision matrix is the optimum value on each criterion as in Equation(1).

$$X = \begin{bmatrix} X01 & X0j & \cdots & X0n \\ Xi0 & Xij & \cdots & Xin \\ \vdots & \vdots & \ddots & \vdots \\ Xn1 & Xmj & \cdots & Xmm \end{bmatrix} (i = 0, \text{m}; \ldots j = 1,\text{n}) \quad (1)$$

Where:

m = number of alternatives

n = number of criteria

X_{ij} = performance value of alternative *i* to criteria *j*

X_{0j} = optimum value of criteria *j*

Equation (2) indicates that if the optimum value of criteria j (*X0j*) is unknown, then:

$$X0j = \frac{max}{i}.Xij, \text{ if } \frac{max}{i}.Xij \text{ is a benefit}$$
$$X0j = \frac{min}{i}.Xij, \text{ if } \frac{min}{i}.Xij \text{ is cost} \quad (2)$$

2. Create a normalized decision matrix for all criteria

In the normalization of the matrix, if the criteria are *beneficial* then normalization is carried out as in Equation (3).

$$Xij^* = \frac{Xij}{\sum_{i=0}^{m} Xij} \quad (3)$$

Where *Xij** is a value that has been normalized. If the criteria are *Non-Beneficial*, then normalization is carried out as in Equation (4).

Step 1: $Xij* = \frac{1}{Xij}$
Step 2: R = $\frac{Xij*}{\sum_{i=0}^{m} Xij*}$ (4)

3. Calculate the weight of the normalized matrix

The calculation of the weight normalizes decision matrix is the result of the multiplication of the normalised decision matrix element (*rij*) and weight value of criteria (*wj*). The calculation formula can be observed in equation (5).

$$D = [dij]mxn = rij.Wj \quad (5)$$

Where:
Wj = criteria weight j

4. Determining the value of the optimization function (*Si*) is shown in Equation (6)

$$Si = \sum_{j=1}^{m} dij; (i = 1,2 ..., m; j = 1,2 ..., n) \quad (6)$$

Si is the value of the alternative optimization function i. The largest value *Si* is the best value and the smallest value *Si* is the worst value. The existence of process considerations makes a relationship between criteria of values and weights that will affect the final result.

5. Determining the highest value level of the alternative is shown in Equation (7)

$$K_i = \frac{Si}{S0} \quad (7)$$

Where Si and S0 are the values of optimality criteria.

C. Metode Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method refers to the understanding that the best-selected alternative not only has the shortest distance from the positive ideal solution but also has the longest distance from the *negative* ideal solution[10]. To solve the problem this method has the following stages:

1. Create a normalised decision matrix indicated by Equation (8)

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (8)$$

i=1,2,….m; and j=1,2,….n.

2. Create a weight normalize decision matrix

TOPSIS requires each alternate weight score (Ai) on each normalised criteria (Cj). Equation (9) shows how to make a normalized decision matrix weighted.

$$y_{ij} = w_i \, . \, r_{ij} \quad (9)$$

With i=1,2,….m; and j=1,2,…..n.

3. Define the positive ideal solution matrix & negative ideal solution matrix

The positive ideal solution (A+) and the negative ideal solution (A-) can be determined based on the normalised weight score (*yij*). Equation (10) shows how to determine the matrix of a positive ideal solution & matrix of a negative ideal solution.

$$A^+ = (y_1^+, y_2^+, ..., y_n^+)$$
$$A^- = (y_1^-, y_2^-, ..., y_n^-) \quad (10)$$

With:
y_j^+ = (max_i, y_{ij}: is the advantage attribute) (min_i, y_{ij}: is the cost attribute)
y_j^- = (max_i, y_{ij}: si the cost attribute) (min_i, y_{ij}: is the profit attribute)

4. Calculates the value distance of each alternative to the positive ideal solution matrix & negative ideal solution matrix

Ai's alternative distance to the positive ideal solution is calculated using equations (11).

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(y_i^+ - y_{ij})^2} \quad (11)$$

Ai's alternative distance to the negative ideal solution is calculated using equations (12).

$$D_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_i^-)^2} \quad (12)$$

5. Preference values determining for each alternative

If the preference calculation value (Vi) is higher, then alternative Ai is the optimal alternative. In determining the preference value of each alternative can be calculated by the equation (13).

$$V_i = \frac{D_i}{D_i^- + D_i^+} \quad (13)$$

D. Accuracy Testing

Accuracy testing is performed to show the proximity of the measurement results of each method with actual rankings. The formulation of accuracy can be seen in the equation (14).

$$\text{Accuracy} = \frac{appropriate\ data}{total\ data} \times 100\ \% \quad (14)$$

E. Hypertext Preprocessor (PHP)

PHP is a standard programming language that resides in HTML documents and runs on server scripts or *server-side* HTML-embedded *scripting*. *Scripts* and instructions will be executed entirely on the server and inserted into regular HTML *scripts* so that PHP scripts are not visible on the *client*-side [11]. PHP is a programming language widely used to manage the development and development of a *web* and is generally written in HTML documents.

F. Website

A website can be defined as a collection of two or more pages on a single domain. It is used to present information using text media, sounds, animations, images, or even a compilation of all media, then presented in static and dynamic pages that are interlocking using a network of pages[12]. The website has hyperlinks and hypertext. Hyperlinks are a series of web pages that are one web page to another, while hypertext is the use of text as a connecting medium.

G. HyperText Markup Language (HTML)

HTML is defined as a standard programming tool for building a website, where a page is accessed it will display various forms of information on an Internet web page (Browser) [13].

H. Unified Modelling Language (UML)

Unified Modelling Language (UML) is a language for modelling a software system or application by viewing a software system or application as an object [14]. UML's basic theory consists of structural classification, dynamic behaviour, and management models. Its theory is always used and will always appear when creating diagrams and system or application views. UML diagrams are often used in system or application modelling such as *Use Case diagram, Activity diagram, Class diagram, Sequence diagram, Statechart diagram, Component diagram, Collaboration diagram,* dan *deployment diagram* [15].

I. Criteria

Criteria in DSS are used as the basis for the assessment of alternatives that have weight. The weight of this assessment makes each criterion have a different level of importance in the DSS. DSS in the selection of practicum assistants uses six criteria as seen in Table I.

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TABLE I
CRITERIA

Code	Criteria	Weight
C1	Practicum Value	0,3
C2	Course value	0,1

C3	Semester	0,25
C4	Asistant How Many Times	0,1
C5	Recommendations	0,2
C6	IPK	0,05

III. RESULT AND DISCUSSION

A. Research Data

This study uses data in the form of a list of practicum assistants selected in 2019 odd semesters and even semesters in 2020, with a total of 110 data. This primary data was obtained directly from the Chemistry Laboratory of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Halu Oleo University.

B. Application of the Manual Calculation Method using the ARAS method

The calculation ARAS method can be applied to obtain results of the best practicum assistant ranking, by taking basis calculations from data of the course assistant "Practicum Inorganic Chemistry 2" even semester 2020.

The first step of this method is to provide alternative values based on all criteria as shown in Table II.

TABLE II
ALTERNATIVE VALUES IN INORGANIC PRACTICUM 2

Alternative	Criteria					
	C1	C2	C3	C4	C5	C6
A1	2	3	1	4	3	5
A2	3	3	1	3	2	3
A3	3	3	1	3	2	3
A4	3	2	3	4	3	3
A5	3	3	1	1	2	4
A6	3	3	3	1	3	3
A7	3	3	3	1	3	3
A8	2	3	3	2	2	3
A9	2	3	3	1	3	3
A10	3	3	3	1	3	2

Next is the formation of the decision matrix and the determination of the A0 value of each criterion as in the matrix below.

$$Xij = \begin{bmatrix} 3 & 3 & 3 & 4 & 3 & 5 \\ 2 & 3 & 1 & 4 & 3 & 5 \\ 3 & 3 & 1 & 3 & 2 & 3 \\ 3 & 3 & 1 & 3 & 2 & 3 \\ 3 & 2 & 3 & 4 & 3 & 3 \\ 3 & 3 & 1 & 1 & 2 & 4 \\ 3 & 3 & 3 & 1 & 3 & 3 \\ 3 & 3 & 3 & 1 & 3 & 3 \\ 2 & 3 & 3 & 2 & 2 & 3 \\ 2 & 3 & 3 & 1 & 3 & 3 \\ 3 & 3 & 3 & 1 & 3 & 2 \end{bmatrix}$$

Next is the normalization of the decision matrix as below.

$$X^* = \begin{bmatrix} 0{,}1000 & 0{,}0938 & 0{,}1200 & 0{,}1600 & 0{,}1034 & 0{,}1351 \\ 0{,}0667 & 0{,}0938 & 0{,}0400 & 0{,}1600 & 0{,}1034 & 0{,}1351 \\ 0{,}1000 & 0{,}0938 & 0{,}0400 & 0{,}1200 & 0{,}0690 & 0{,}0811 \\ 0{,}1000 & 0{,}0938 & 0{,}0400 & 0{,}1200 & 0{,}0690 & 0{,}0811 \\ 0{,}1000 & 0{,}0938 & 0{,}1200 & 0{,}1600 & 0{,}1034 & 0{,}0811 \\ 0{,}1000 & 0{,}0938 & 0{,}0400 & 0{,}0400 & 0{,}0690 & 0{,}1081 \\ 0{,}1000 & 0{,}0938 & 0{,}1200 & 0{,}0400 & 0{,}1034 & 0{,}0811 \\ 0{,}1000 & 0{,}0938 & 0{,}1200 & 0{,}0400 & 0{,}1034 & 0{,}0811 \\ 0{,}0667 & 0{,}0938 & 0{,}1200 & 0{,}0800 & 0{,}0690 & 0{,}0811 \\ 0{,}0667 & 0{,}0938 & 0{,}1200 & 0{,}0400 & 0{,}1034 & 0{,}0811 \\ 0{,}1000 & 0{,}0938 & 0{,}1200 & 0{,}0400 & 0{,}1034 & 0{,}0541 \end{bmatrix}$$

Next, calculate the weight of the normalized matrix based on equation (5).

$$D = \begin{bmatrix} 0{,}0300 & 0{,}0094 & 0{,}0300 & 0{,}0160 & 0{,}0207 & 0{,}0068 \\ 0{,}0200 & 0{,}0094 & 0{,}0100 & 0{,}0160 & 0{,}0207 & 0{,}0068 \\ 0{,}0300 & 0{,}0094 & 0{,}0100 & 0{,}0120 & 0{,}0138 & 0{,}0041 \\ 0{,}0300 & 0{,}0094 & 0{,}0100 & 0{,}0120 & 0{,}0138 & 0{,}0041 \\ 0{,}0300 & 0{,}0063 & 0{,}0300 & 0{,}0160 & 0{,}0207 & 0{,}0041 \\ 0{,}0300 & 0{,}0094 & 0{,}0100 & 0{,}0040 & 0{,}0138 & 0{,}0054 \\ 0{,}0300 & 0{,}0094 & 0{,}0300 & 0{,}0040 & 0{,}0207 & 0{,}0041 \\ 0{,}0300 & 0{,}0094 & 0{,}0300 & 0{,}0040 & 0{,}0207 & 0{,}0041 \\ 0{,}0200 & 0{,}0094 & 0{,}0300 & 0{,}0080 & 0{,}0138 & 0{,}0041 \\ 0{,}0200 & 0{,}0094 & 0{,}0300 & 0{,}0040 & 0{,}0207 & 0{,}0041 \\ 0{,}0300 & 0{,}0094 & 0{,}0300 & 0{,}0040 & 0{,}0207 & 0{,}0027 \end{bmatrix}$$

Next is the determination of the value of the optimization function (Si) of each alternative as below.

S0 : 0,0300 + 0,0094 + 0,0300 + 0,0160 + 0,0207 + 0,0068 = 0,1128

S1 : 0,0200 + 0,0094 + 0,0100 + 0,0160 + 0,0207 + 0,0068 = 0,0828

S2 : 0,0300 + 0,0094 + 0,0100 + 0,0120 + 0,0138 + 0,0041 = 0,0792

S3 : 0,0300 + 0,0094 + 0,0100 + 0,0120 + 0,0138 + 0,0041 = 0,0792

S4 : 0,0300 + 0,0063 + 0,0300 + 0,0160 + 0,0207 + 0,0041 = 0,1070

S5 : 0,0300 + 0,0094 + 0,0100 + 0,0400 + 0,0138 + 0,0054 = 0,0726

S6 : 0,0300 + 0,0094 + 0,0300 + 0,0400 + 0,0207 + 0,0041 = 0,0981

S7 : 0,0300 + 0,0094 + 0,0300 + 0,0400 + 0,0207 + 0,0041 = 0,0981

S8 : 0,0200 + 0,0094 + 0,0300 + 0,0080 + 0,0138 + 0,0041 = 0,0852

S9 : 0,0200 + 0,0094 + 0,0300 + 0,0040 + 0,0207 + 0,0041 = 0,0881

S10 : 0,0300 + 0,0094 + 0,0300 + 0,0040 + 0,0207 + 0,0027 = 0,0968

Next is to calculate the rank of all alternatives by the formula of each value of the alternative divided by the alternative value A0 as below.

K0 : 0,1128/0,1128 = 1
K1 : 0,0828/0,1128 = 0,7341
K2 : 0,0792/0,1128 = 0,7022
K3 : 0,0792/0,1128 = 0,7022
K4 : 0,1070/0,1128 = 0,9483
K5 : 0,0726/0,1128 = 0,6433
K6 : 0,0981/0,1128 = 0,8697
K7 : 0,0981/0,1128 = 0,8697
K8 : 0,0852/0,1128 = 0,7554
K9 : 0,0881/0,1128 = 0,7810
K10 : 0,0968/0,1128 = 0,8577

The ranking results from highest to lowest can be seen in Table III.

TABLE III
RANKING RESULTS WITH ARAS METHOD

No	Alternative	Value
1	Bikra Ali Akbar (A4)	0,9483
2	Marsia Andra (A7)	0,8697
3	Linda Apriani (A6)	0,8697
4	Ferdi Ichsan I (A10)	0,8577
5	Sari Mulyani (A9)	0,7810
6	Johan Ariano (A8)	0,7554
7	Excelloora Andrian (A1)	0,7341
8	Nurannisa (A2)	0,7022
9	Rezky Nurul I (A3)	0,7022
10	Zul Athfin Listiani (A5)	0,6433

C. Application of TOPSIS Method Manual Calculation Method

The calculation flow of the TOPSIS method to obtain the results of the best practicum assistant ranking is taken for example the data of the course "Practicum Inorganic Chemistry 2" even semester 2020.

The initial stage of the TOPSIS method is to create a decision matrix based on data in Table II with the following details.

$$D = \begin{bmatrix} 2 & 3 & 1 & 4 & 3 & 5 \\ 3 & 3 & 1 & 3 & 2 & 3 \\ 3 & 3 & 1 & 3 & 2 & 3 \\ 3 & 2 & 3 & 4 & 3 & 3 \\ 3 & 3 & 1 & 1 & 2 & 4 \\ 3 & 3 & 3 & 1 & 3 & 3 \\ 3 & 3 & 3 & 1 & 3 & 3 \\ 2 & 3 & 3 & 2 & 2 & 3 \\ 2 & 3 & 3 & 1 & 3 & 3 \\ 3 & 3 & 3 & 1 & 3 & 2 \end{bmatrix}$$

Furthermore, the data will be processed into the R decision matrix, which is a normalized matrix as below.

$$R = \begin{bmatrix} 0{,}2309 & 0{,}3254 & 0{,}1313 & 0{,}5208 & 0{,}3586 & 0{,}4811 \\ 0{,}3464 & 0{,}3254 & 0{,}1313 & 0{,}3906 & 0{,}2390 & 0{,}2887 \\ 0{,}3464 & 0{,}3254 & 0{,}1313 & 0{,}3906 & 0{,}2390 & 0{,}2887 \\ 0{,}3464 & 0{,}2169 & 0{,}3939 & 0{,}5208 & 0{,}3586 & 0{,}2887 \\ 0{,}3464 & 0{,}3254 & 0{,}1313 & 0{,}1302 & 0{,}2390 & 0{,}3849 \\ 0{,}3464 & 0{,}3254 & 0{,}3939 & 0{,}1302 & 0{,}3586 & 0{,}2887 \\ 0{,}3464 & 0{,}3254 & 0{,}3939 & 0{,}1302 & 0{,}3586 & 0{,}2887 \\ 0{,}2309 & 0{,}3254 & 0{,}3939 & 0{,}2604 & 0{,}2390 & 0{,}2887 \\ 0{,}2309 & 0{,}3254 & 0{,}3939 & 0{,}1302 & 0{,}3586 & 0{,}2887 \\ 0{,}3464 & 0{,}3254 & 0{,}3939 & 0{,}1302 & 0{,}3586 & 0{,}1925 \end{bmatrix}$$

Then proceed to make the normalized decision matrix weighted by calculating the elements present in the previous normalized matrix *(R)* with the following details.

$$Y = \begin{bmatrix} 0{,}0693 & 0{,}0325 & 0{,}0328 & 0{,}0521 & 0{,}0717 & 0{,}0241 \\ 0{,}1039 & 0{,}0325 & 0{,}0328 & 0{,}0391 & 0{,}0478 & 0{,}0144 \\ 0{,}1039 & 0{,}0325 & 0{,}0328 & 0{,}0391 & 0{,}0478 & 0{,}0144 \\ 0{,}1039 & 0{,}0217 & 0{,}0985 & 0{,}0521 & 0{,}0717 & 0{,}0144 \\ 0{,}1039 & 0{,}0325 & 0{,}0328 & 0{,}0130 & 0{,}0478 & 0{,}0192 \\ 0{,}1039 & 0{,}0325 & 0{,}0985 & 0{,}0130 & 0{,}0717 & 0{,}0144 \\ 0{,}1039 & 0{,}0325 & 0{,}0985 & 0{,}0130 & 0{,}0717 & 0{,}0144 \\ 0{,}0693 & 0{,}0325 & 0{,}0985 & 0{,}0260 & 0{,}0478 & 0{,}0144 \\ 0{,}0693 & 0{,}0325 & 0{,}0985 & 0{,}0130 & 0{,}0717 & 0{,}0144 \\ 0{,}1039 & 0{,}0325 & 0{,}0985 & 0{,}0130 & 0{,}0717 & 0{,}0096 \end{bmatrix}$$

After the matrix the ideal solution value is positive and the ideal solution value is negative from the weighted decision matrix (Y) with the details below.

$$A+ = [0{,}1039 \quad 0{,}0325 \quad 0{,}0985 \quad 0{,}0521 \quad 0{,}0717 \quad 0{,}0241]$$
$$A- = [0{,}0693 \quad 0{,}0217 \quad 0{,}0328 \quad 0{,}0130 \quad 0{,}0478 \quad 0{,}0096]$$

Furthermore, calculate the positive ideal solution distance value and the negative ideal solution distance value as described below.

$$D_1^+ = \sqrt{(0{,}1039-0{,}0693)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0328)^2+(0{,}0521-0{,}0521)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0241)^2 = \mathbf{0{,}0742}$$

$$D_2^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0328)^2+(0{,}0521-0{,}0391)^2}+(0{,}0717-0{,}0478)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0717}$$

$$D_3^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0328)^2+(0{,}0521-0{,}0391)^2}+(0{,}0717-0{,}0478)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0717}$$

$$D_4^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0217)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0521)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0145}$$

$$D_5^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0328)^2+(0{,}0521-0{,}0130)^2}+(0{,}0717-0{,}0478)^2+(0{,}0241-0{,}0192)^2 = \mathbf{0{,}0802}$$

$$D_6^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0130)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0402}$$

$$D_7^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0130)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0402}$$

$$D_8^+ = \sqrt{(0{,}1039-0{,}0693)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0260)^2}+(0{,}0717-0{,}0478)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0504}$$

$$D_9^+ = \sqrt{(0{,}1039-0{,}0693)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0130)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0144)^2 = \mathbf{0{,}0531}$$

$$D_{10}^+ = \sqrt{(0{,}1039-0{,}1039)^2+(0{,}0325-0{,}0325)^2+(0{,}0985-0{,}0985)^2+(0{,}0521-0{,}0130)^2}+(0{,}0717-0{,}0717)^2+(0{,}0241-0{,}0096)^2 = \mathbf{0{,}041}$$

$$D_1^- = \sqrt{(0{,}0693-0{,}0693)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0328)^2+(0{,}0130-0{,}0521)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0241)^2 = \mathbf{0{,}0492}$$

$$D_2^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0328)^2+(0{,}0130-0{,}0391)^2}+(0{,}0478-0{,}0478)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0449}$$

$$D_3^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0328)^2+(0{,}0130-0{,}0391)^2}+(0{,}0478-0{,}0478)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0449}$$

$$D_4^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0217)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0521)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0874}$$

$$D_5^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0328)^2+(0{,}0130-0{,}0130)^2}+(0{,}0478-0{,}0478)^2+(0{,}0096-0{,}0192)^2 = \mathbf{0{,}0376}$$

$$D_6^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0130)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0789}$$

$$D_7^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0130)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0789}$$

$$D_8^- = \sqrt{(0{,}0693-0{,}0693)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0260)^2}+(0{,}0478-0{,}0478)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0680}$$

$$D_9^- = \sqrt{(0{,}0693-0{,}0693)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0130)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0144)^2 = \mathbf{0{,}0709}$$

$$D_{10}^- = \sqrt{(0{,}0693-0{,}1039)^2+(0{,}0217-0{,}0325)^2+(0{,}0328-0{,}0985)^2+(0{,}0130-0{,}0130)^2}+(0{,}0478-0{,}0717)^2+(0{,}0096-0{,}0096)^2 = \mathbf{0{,}0787}$$

Next, calculate the preference value of each alternative according to the distance of the ideal positive and negative solution.

$$V^1 = \frac{0{,}0492}{(0{,}0492+0{,}0742)} = 0{,}3987$$

$$V^2 = \frac{0{,}0449}{(0{,}0449+0{,}0717)} = 0{,}3852$$

$$V^3 = \frac{0{,}0449}{(0{,}0449+0{,}0717)} = 0{,}3852$$

$$V^4 = \frac{0{,}0874}{(0{,}0874+0{,}0145)} = 0{,}8576$$

$$V^5 = \frac{0{,}0376}{(0{,}0376+0{,}0802)} = 0{,}3189$$

$$V^6 = \frac{0{,}0789}{(0{,}0789+0{,}0402)} = 0{,}6623$$

$$V^7 = \frac{0{,}0789}{(0{,}0789+0{,}0402)} = 0{,}6623$$

$$V^8 = \frac{0{,}0680}{(0{,}0680+0{,}0504)} = 0{,}5741$$

$$V^9 = \frac{0{,}0709}{(0{,}0709+0{,}0531)} = 0{,}5717$$

$$V^{10} = \frac{0{,}0787}{(0{,}0787+0{,}0416)} = 0{,}6541$$

After calculating the preferences, the next is to determine the alternative ranking from the highest rank to the lowest rank in order as below.

TABLE IV
RANKING RESULTS WITH TOPSIS METHOD

No	Alternative	Value
1	Bikra Ali Akbar (A4)	0,8567
2	Marsia Andra (A7)	0,6623
3	Linda Apriani (A6)	0,6623
4	Ferdi Ichsan I (A10)	0,6541
5	Johan Arianto (A8)	0,5741
6	Sri Mulyani (A9)	0,5717
7	Excelloora Andrian (A1)	0,3987
8	Nurannisa (A2)	0,3852
9	Rezky Nurul I (A3)	0, 3852
10	Zul Athfin Listiani (A5)	0,3189

D. Accuracy Test Results

The ranking that is a reference in accuracy testing is the ranking of the results of the meeting of the head of the laboratory and all lecturers who attend practicum courses. This test uses odd semester practicum courses in 2019 with details such as in Table V.

TABLE V
ACCUARCY TESTING

Courses	Selection By Meeting	Selection by ARAS Method	Selection by TOPSIS Method	Courses	Selection By Meeting	Selection by ARAS Method	Selection by TOPSIS Method

General Biochemical Practicum	1. Grace wara P 2. Sudarlin 3. Nur Hikmawati 4. Iwan Jaya S 5. St. Hadijah 6. Rizka Dzulmuthia N.M 7. St. Haerani 8. Johan Arianto 9. Sunita 10. Yolanda L.T	1. Grace wara P 2. Nur Hikmawati 3. Sudarlin 4. Iwan Jaya S 5. Johan Arianto 6. St. Hadijah 7. St. Haerani 8. Yolanda L.T 9. Sunita 10. Rizka Dzulmuthia N.M	1. Grace wara P 2. Nur Hikmawati 3. Sudarlin 4. Iwan Jaya S 5. St. Hadijah 6. Johan Arianto 7. St. Haerani 8. Yolanda L.T 9. Sunita 10. Rizka Dzulmuthia N.MZ	General Microbiology Practicum	1. Yolanda L.T 2. Nur Amalia 3. Grace Wara P 4. Rizka Dzulmuthia N.M 5. Zul Athfin Listiani 6. Muh. Ilham Faris 7. Wa Nazila 8. Muh. Mahatir 9. Irmawati 10. Annisa Indriani	1. Yolanda L.T 2. Nur Amalia 3. Rizka Dzulmuthia N.M 4. Grace Wara P 5. Zul Athfin Listiani 6. Wa Nazila 7. Muh. Ilham Faris 8. Annisa Indriani 9. Irmawati 10. Muh. Mahatir	1. Yolanda L.T 2. Nur Amalia 3. Rizka Dzulmuthia N.M 4. Grace Wara P 5. Zul Athfin Listiani 6. Muh. Ilham Faris 7. Wa Nazila 8. Annisa Indriani 9. Irmawati 10. Muh. Mahatir
Practicum of Inorganic Chemistry 2	1. Bikra Ali Akbar 2. Johan Arianto 3. Linda Apriani 4. Marsia Andra 5. Zul Athfin Listiani 6. Ferdi Ichsan I 7. Sari Mulyani 8. Nurannisa 9. Rezky Nurul I 10. Excelloora Andrian	1. Bikra Ali Akbar 2. Marsia Andra 3. Linda Apriani 4. Ferdi Ichsan I 5. Sari Mulyani 6. Johan Arianto 7. Excelloora Andrian 8. Nurannisa 9. Rezky Nurul I 10. Zul Athfin Listiani	1. Bikra Ali Akbar 2. Marsia Andra 3. Linda Apriani 4. Ferdi Ichsan 5. Johan Arianto 6. Sari Mulyani 7. Excelloora Andrian 8. Johan Arianto 9. Rezky Nurul I 10. Zul Athfin Listiani	Spectroscopy Instrument Practicum	1. Irmawati 2. Salsha Ramadhana 3. Zulfikar Laode 4. Adyatna 5. WD. Tuti Asndari 6. Sri Wahyuningsih K 7. Wahyu 8. Muh. Fajar 9. Muh. Saleh 10. Faradilla Rachman	1. Adyatna 2. Salsha Ramadhana 3. Zulfikar Laode 4. WD. Tuti Asndari 5. Irmawati 6. Wahyu 7. Sri Wahyuningsi K 8. Muh. Saleh R.P 9. Muh. Fajar 10. Faradilla Rachman	1. Adyatna 2. Salsha Ramadhana 3. Zulfikar Laode 4. WD. Tuti Asndari 5. Irmawati 6. Sri Wahyuningsi K 7. Wahyu 8. Muh. Saleh R.P 9. Muh. Fajar 10. Faradilla Rachman
Analytical Chemistry Practicum	1. Jumardin Djalili 2. Muh. Fajar 3. St. Aisyah Hasyim 4. Chindy Prina A 5. Wa Nazila 6. Yulianti Ika P 7. Sarifa Rahmatilah 8. Salsha Ramadhan 9. Nanda Permana Jati 10. Nur Hikmawati	1. Jumardin Djalili 2. Muh. Fajar 3. St. Aisyah Hasyim 4. Sarifa Rahmatilh 5. Chindy Prina A 6. Yulianti Ika P 7. Wa Nazila 8. Salsha Ramadhan 9. Nanda Permana Jati 10. Nur Hikmawati	1. Jumardin Djalili 2. Muh. Fajar 3. St. Aisyah Hasyim 4. Sarifa Rahmatilah 5. Yulianti Ika P 6. Wa Nazila 7. Chindy Prina A 8. Salsha Ramadhan 9. Nanda Permana Jati 10. Nur Hikmawati				

Based on Table V above, the results of the accurate calculation of the two methods used can be seen below.

ARAS Accuracy = $\frac{22}{50} \times 100\ \% = 44\ \%$

TOPSIS Accuracy = $\frac{25}{50} \times 100\ \% = 50\ \%$

The results of the calculations above show that the TOPSIS method is a method that produces the highest accuracy value.

E. System Diagram Use Case Design

The use case diagram shown in Figure 1 shows all *actors* interacting with the system and the functions that will be executed in the system.

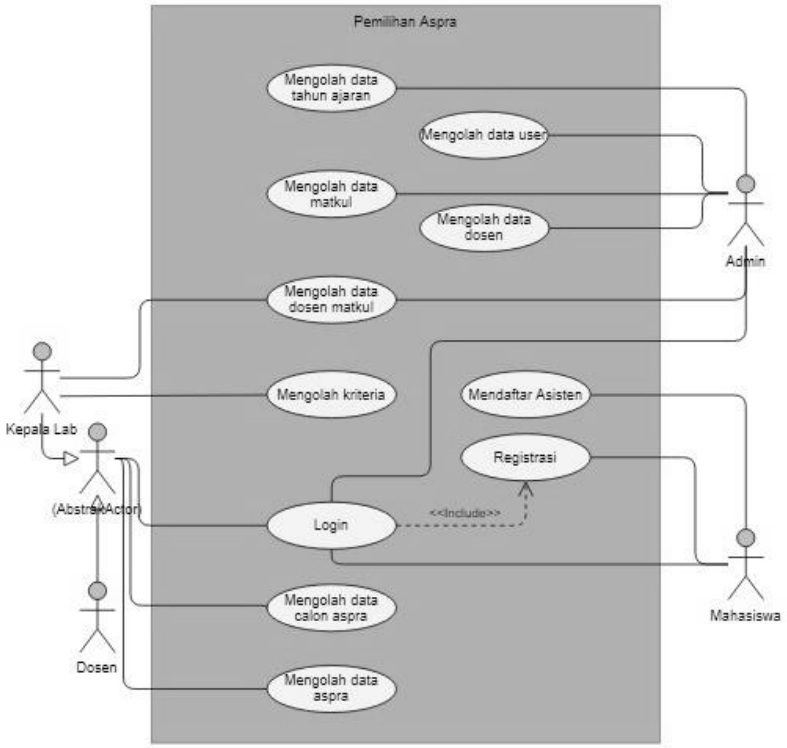

Figure. 1. System *Diagram Use Case* Design

F. System Diagram Activity Design

Figure 2 is a picture of system activity starting from students filling out *the* practicum assistant registration form until the selection of practicum assistants based on TOPSIS and ARAS calculations.

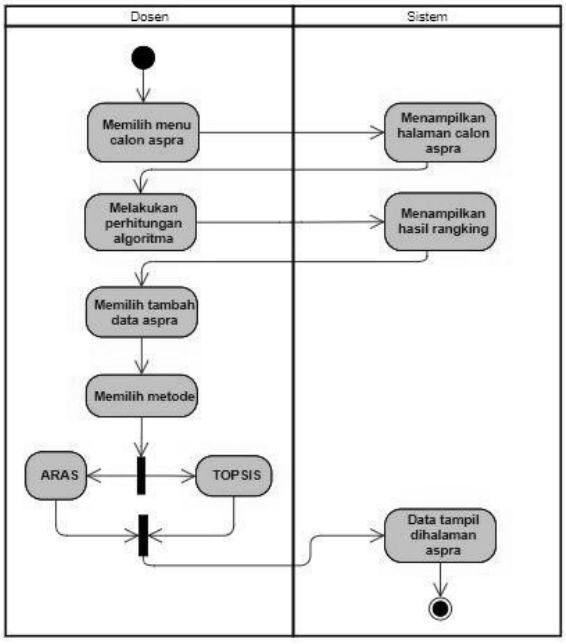

Figure. 2. System *Diagram Activity* Design

G. Page View of List Practicum Assistants

The application used by students applying to become practicum assistants is a mobile application. The view of the practicum assistant registration form page can be seen in Figure 3. The data that must be filled in on this page is the name of the course to be listed, practicum value, the value of the course from the practicum, the semester that is being taped, the status of ever or not to be a practicum assistant, and the cumulative Achievement Index (GPA).

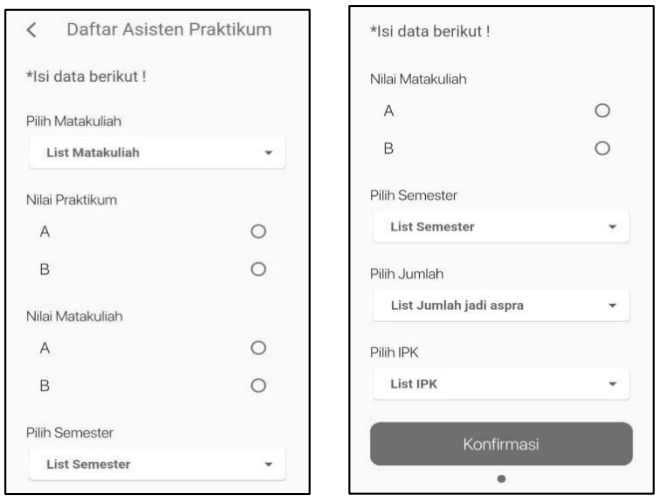

Figure. 3. Practicum Assistant List Page View

H. Administrator Page View

The administrator is in charge of managing all master data, both teaching year data, user data, and course data. As for one of the *administrator* page views as seen in Figure 4.

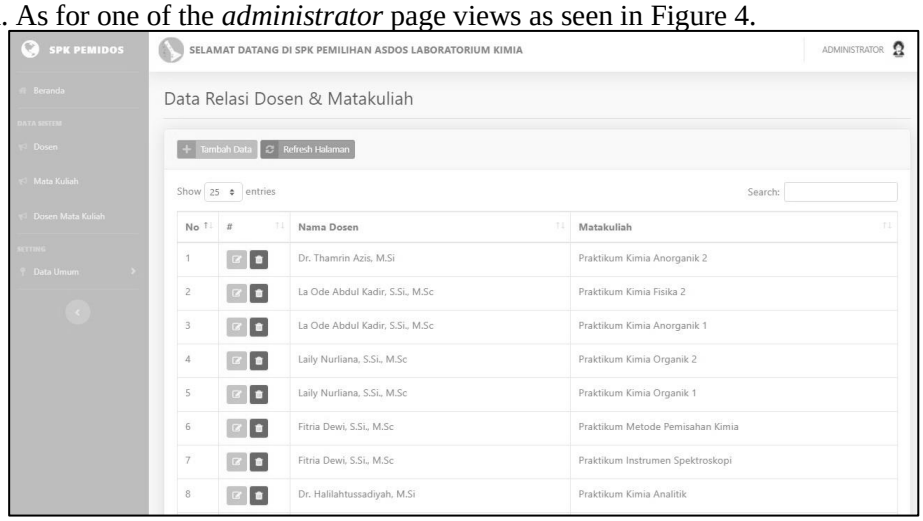

Figure 4. Administrator Page View

I. Laboratory Head Page View

The Head of the Laboratory is in charge of managing the criteria data and data of lecturers who study courses (practicum). The head of the laboratory can only display and view the list of prospective practicum assistants. As for the page view for the head of the laboratory as seen in Figure 5 and Figure 6.

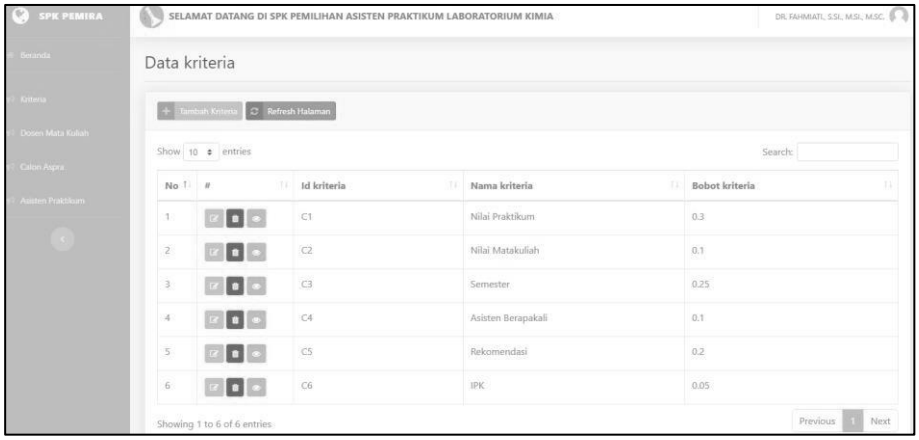

Figure 5. Laboratory Head Page View 1

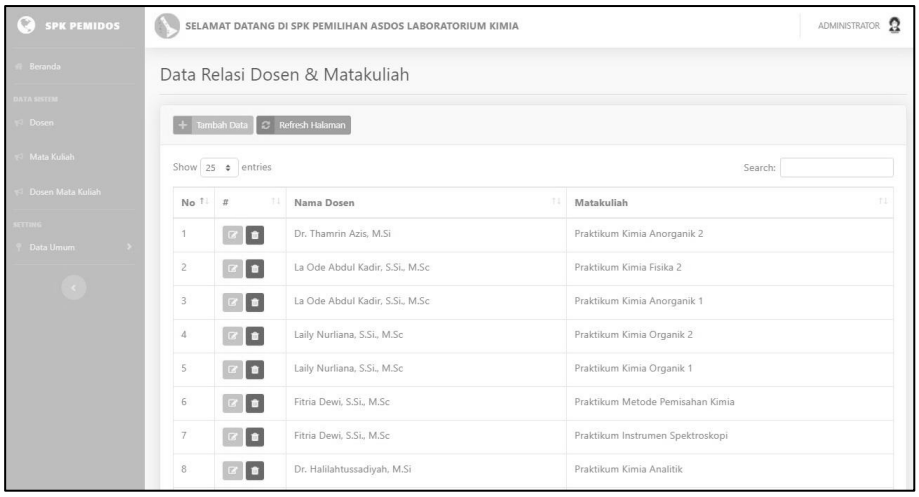

Figure 6. Laboratory Head Page View 2

J. Page View of the Course Lecture (Practicum)

Lecturer courses (practicum) are in charge of collecting data on prospective practicum assistants and collecting data on selected practicum assistants. On this page, the lecturer runs the calculation process to select prospective assistants (as seen in Figure 7) until the final result of the list of prospective assistants is sorted based on the weight of the CALCULATION of the ARAS method and TOPSIS method (as seen in Figure 8). Prospective assistants selected by the lecturer will appear on the practicum assistant page as seen in Figure 9.

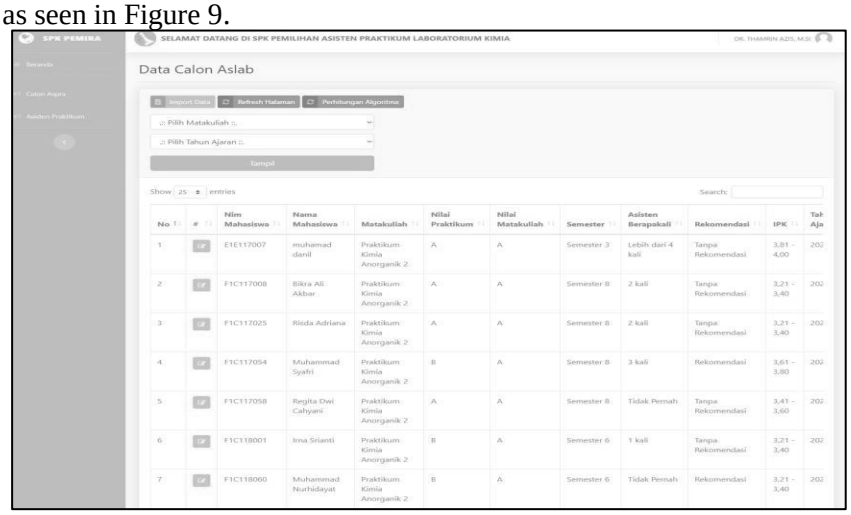

Figure 7. Page View of the Course Lecture (Practicum) 1

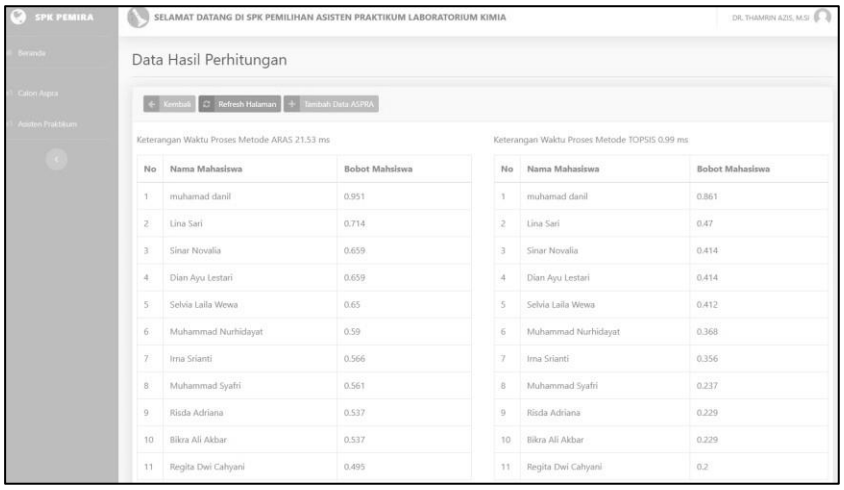

Figure 8. Page View of the Course Lecture (Practicum) 2

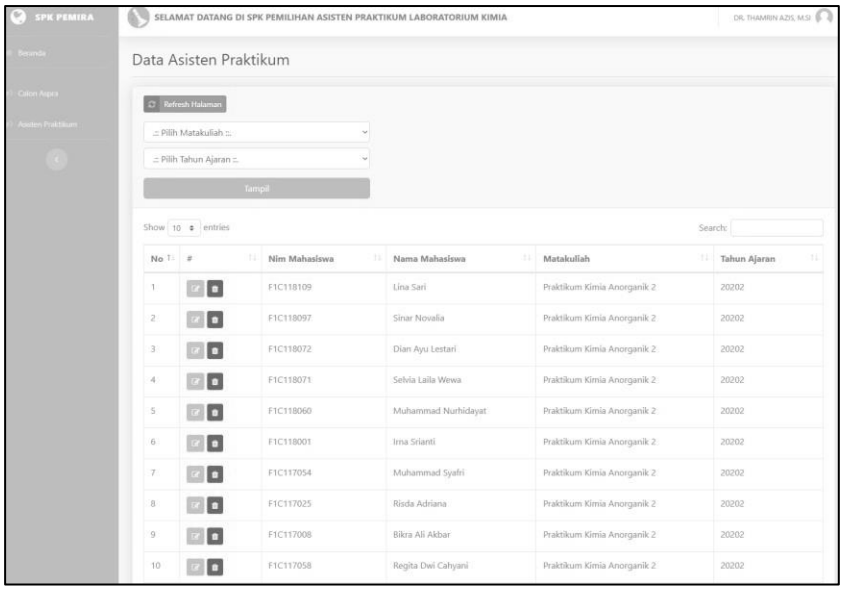

Figure 9. Page View of the Course Lecture (Practicum) 3

K. Method Speed Testing

Speed testing is intended at knowing which method is the fastest in processing data based on the calculation stages of each method. This test uses the course "Practicum Organic Chemistry 2". The results of the speed test seen in Table VI and Table VII show that the ARAS method is faster than the TOPSIS method.

TABLE VI
ARAS METHOD SPEED TESTING

Internship	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment 8	Experiment 9	Experiment 10	Average (ms)
Organic Chemistry 2	0,09	0,1	0,1	0,06	0,11	0,09	0,08	0,09	0,09	0,09	0,09
Chemistry Inorganic 2	0,09	0,08	0,09	0,09	0,09	0,09	0,09	0,1	0,08	0,1	0,09
Chemistry Physics 2	0,09	0,09	0,09	0,08	0,09	0,09	0,09	0,09	0,07	0,09	0,087
Method Chemical Separation	0,1	0,09	0,11	0,1	0,09	0,12	0,1	0,1	0,1	0,11	0,102
						Average (ms)					0,09225

TABLE VII
TOPSIS METHOD SPEED TESTING

Internship	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment 8	Experiment 9	Experiment 10	Average (ms)
Organic Chemistry 2	0,09	0,08	0,08	0,06	0,09	0,08	0,09	0,09	0,09	0,09	0,084
Chemistry Inorganic 2	0,1	0,12	0,1	0,1	0,1	0,09	0,08	0,1	0,09	0,1	0,098
Chemistry Physics 2	0,09	0,1	0,1	0,08	0,11	0,09	0,13	0,09	0,05	0,1	0,094
Method Chemical Separation	0,12	0,09	0,1	0,11	0,09	0,1	0,1	0,13	0,1	0,1	0,104
						Average (ms)					0,09

IV. CONCLUSION

In this study, a comparative analysis has been conducted in the application of the ARAS method with the application of the TOPSIS method to the decision support system for the selection of the best practicum assistant at the Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences. The results of the analysis obtained several conclusions, among others:

1. Additive *Ratio Assessment* method and *Technique for Others Reference by Similarity to Ideal Solution* method can be implemented as supporting media in the selection of practicum assistants at the FMIPA Chemical Laboratory. The results showed a higher degree of accuracy resulting from the TOPSIS method than the ARAS method of 50%
2. The results of the duration of speed testing in even semester courses prove that the ARAS method in processing data is faster than the TOPSIS method.
3. The application for selecting the practicum assistant of the FMIPA Chemical Laboratory was successfully built with *the website* and *android* platform.

REFERENCE

[1] H. Willy, "Sistem Informasi Pendukung Pengambilan Keputusan Untuk Menilai Karyawan Berprestasi Di Pt. Nucifera Alam Indonesia Dengan …," 2018, [Online]. Available: http://repositori.buddhidharma.ac.id/id/eprint/845.

[2] T. R. Sitompul and N. A. Hasibuan, "Sistem Pendukung Keputusan Seleksi Tenaga Kerja Untuk Security Service Menggunakan Metode Aras," *J. Media Inform. Budidarma*, vol. 2, no. 1, pp. 1–9, 2018, doi: 10.30865/mib.v2i1.812.

[3] D. M. Midyanti, R. Hidyati, S. Bahri, and U. T. Pontianak, "Rumah Di Kota Pontianak," vol. 4, no. 2, pp. 119–124, 2019.

[4] D. Karabašević, M. Maksimović, D. Stanujkić, G. Jocić, and D. Rajčević, "Selection of software testing method by using ARAS method," *Tehnika*, vol. 73, no. 5, pp. 724–729, 2018, doi: 10.5937/tehnika1805724k.

[5] I. W. Pratama, "Sistem Pendukung Keputusan Evaluasi Kinerja Dosen dengan Metode Technique For Order By Similarity To Ideal Solution (Topsis) & Preference Ranking Organization For Evaluation (Promethee)," *J. Cendekia*, vol. XV, no. April, pp. 35–42, 2018.

[6] A. H. Nasyuha, M. Dahria, and T. Tugiono, "Sistem Pendukung Keputusan Pemilihan Mandor Menggunakan Metode Topsis," *J. Ilm. Saintikom*, vol. 16, no. 1, pp. 77–86, 2017.

[7] R. Fachrizal, "IMPLEMENTASI ARAS (Additive Ratio Assessment) DALAM PEMILIHAN KASIR TERBAIK STUDI KASUS OUTLET CARDINAL STORE PLAZA MEDAN FAIR," *Sainteks*, no. Januari, pp. 501–510, 2019.

[8] H. Loardi and S. Kharisma Makassar, "Sistem Penunjang Keputusan Pemilihan Souvenir Pada Hotel Lestari Makassar Dengan Metode Topsis," *Jtriste*, vol. 5, no. 1, pp. 57–65, 2018.

[9] A. A. Suryani and D. Ernawati, "Pemilihan Mitra Kerja Pemanfaatan Limbah Jonjot Menggunakan Metode Aras (Additive Ratio Assessment) Di Perum Xyz," *Juminten*, vol. 1, no. 4, pp. 37–48, 2020, doi: 10.33005/juminten.v1i4.104.

[10] I. Muzakkir, "Penerapan Metode Topsis Untuk Sistem Pendukung Keputusan Penentuan Keluarga Miskin Pada Desa Panca Karsa Ii," *Ilk. J. Ilm.*, vol. 9, no. 3, pp. 274–281, 2017, doi: 10.33096/ilkom.v9i3.156.274-281.

[11] L. H. Laisina, M. a. . Haurissa, and Z. Hatala, "Sistem Informasi Data Jemaat GPM Gidion Waiyari Ambon dan Jemaat GPM Halong Anugerah Ambon," *J. Simetrik*, vol. 8, no. 2, pp. 139–144, 2018.

[12] A. Josi, "Penerapan Metode Prototyping Dalam Membangun Website Desa (Studi Kasus Desa Sugihan Kecamatan Rambang)," *Jti*, vol. 9, no. 1, pp. 50–57, 2017.

[13] N. B. Nugroho and B. Anwar, "Desain web menggunakan html dan javascript," *J. SAINTIKOM*, vol. 4, no. 1, pp. 96–110, 2008, [Online]. Available: https://lppm.trigunadharma.ac.id/public/fileJurnal/DBEF1-OK-Jurnal10-Cahyo-BY-DesainWeb1.pdf.

[14] R. Ansari and N. Subairi, "Implementasi Uml Pada Sistem Penjadwalan Mata Kuliah," *J. Teknol. Inf. Univ. Lambung Mangkurat*, vol. 5, no. 1, pp. 1–10, 2020, doi: 10.20527/jtiulm.v5i1.47.

[15] Suendri, "Implementasi Diagram UML (Unified Modelling Language) Pada Perancangan Sistem Informasi Remunerasi Dosen Dengan Database Oracle (Studi Kasus: UIN Sumatera Utara Medan)," *J. Ilmu Komput. dan Inform.*, vol. 3, no. 1, pp. 1–9, 2018, [Online]. Available: http://jurnal.uinsu.ac.id/index.php/algoritma/article/download/3148/1871.