*Article*

# Decision Support System of Students Recruitment as Teacher Candidates using Multi-level Multi-Attribute Utility Theory (MAUT)

**Muharram[1], Bakhrani A. Rauf[2], Muhammad Agung[3], Yohandri[4], Baharuddin[5], I Nyoman Sila[6], Suyanta[7], Usman Mulbar[8], Abdul Wahid[9*], Jumadi M. Parenreng[10], Abdul Saman[11], Yasdin[12], Amirullah Abduh[13], Muhammad Fajar B[14], M. Syahid Nur Wahid[15]**

[1,2,3,8,9,10,11,12,13,14,15]Universitas Negeri Makassar, Jl. A.P. Pettarani, Makassar 90222, Indonesia;
[1]muharram_pasma@yahoo.com,[2] bakhrani@unm.ac.id, [3]agung@unm.ac.id,[8] u_mulbar@unm.ac.id,[9] wahid@unm.ac.id, [10]jparenreng@unm.ac.id, [11]absan_unm@yahoo.co.id,[12]yasdin@unm.ac.id, [13]amirullah@unm.ac.id, [14]fajarb@unm.ac.id, [15]syahid@unm.ac.id
[2]Universitas Negeri Makassar, Jl. A.P. Pettarani, Makassar 90222, Indonesia;bakhrani@unm.ac.id,
[3]Universitas Negeri Makassar, Jl. A.P. Pettarani, Makassar 90222, Indonesia;agung@unm.ac.id,
[4]Universitas Negeri Padang, Jl. Prof. Dr. Hamka No. 1, Padang 25173, yohandri@fmipa.unp.ac.id,
[5]Universitas Negeri Medan, Jl. Willem Iskandar, Medan 20221, Indonesia; baharuddin.bah@gmail.com,
[6]Universitas Pendidikan Ganesha, Jl. Udayana No.11, Singaraja 81116, Indonesia; nyoman.sila@undiksha.ac.id,
[7]Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia; ytakimiauny@yahoo.com

* Corresponding author: wahid@unm.ac.id

**Citation:** Muharram, et.al, Decision Support System of Students Recruitment as Teacher Candidates using Multilevel Multi Attribute Utility Theory (MAUT), *Iota*, **2022**, ISSN 2774-4353, Vol.02, 02. https://doi.org/10.31763/iota.v2i2.513

Academic Editor : P.D.P.Adi

Received : 14 May 2022

Accepted : 18 May 2022

Published : 31 May 2022



**Abstract:** Recruitment is an essential aspect of human resource management at a university, particularly at Makassar State University. Selection is a step in the recruitment process that determines whether prospective students who apply are a good fit for the program of study. The advancement of information systems facilitates the recruitment registration process. Currently, the assessment system for prospective student teachers is still lacking. In this study, we developed a system and an assessment rubric that was reviewed based on a theoretical approach that affects interests, personality, appearance, and academic ability. The decision support system is present to assist decision-makers in receiving appropriate recommendations for prospective teacher students who have been selected. The proposed research aims to assess prospective teacher students' graduation ranking based on the assessment indicators from the compiled rubric. This study employs the MAUT method's development, which is carried out in stages, hence the Multi-Level MAUT, combined with Min-Max Normalization. Because assessment metrics are classified, we combine several MAUT methods to reach a final decision. The algorithm produces good results, namely the ability to rank correctly based on stakeholder preferences.

**Keywords:** Decision Support System, Multi-Attribute Utility Theory, Student Recruitment, Teacher Candidate Recruitment

## 1. Introduction

The new student recruitment system is one of the most important aspects of human resource management for students planning to attend a university, particularly for Educational Personnel Education Institutions (Lembaga Pendidikan Tenaga Kependidikan or LPTK). This is due to the LPTK's uniqueness, as its output will be a teacher with special interests and talents. Selection is a part of the recruitment process that determines whether prospective students who apply are appropriate for the intended study program and have the necessary interests and talents for this teaching

profession [1]–[3]. The university records new students who register and re-register using a new student admissions information system.

In the system to measure competencies, we call them "hard abilities," such as educational background, knowledge and skills, qualification certificates, languages, etc. On the other side, we call some competencies "soft abilities," such as personal characteristics, performance level, etc. [4]. As the process has progressed, the number of new student registrant data has increased from year to year, necessitating developing an assessment system capable of accurately assessing the ability and suitability of prospective students. Interests, personality, portfolio, and academic tests are all components that can be used as assessment indicators [5], [6].

This study proposes a Decision Support System (D.S.S.) based on Multi-Attribute Utility Theory (MAUT) to analyze portfolio value. The MAUT method is a quantitative comparison method that incorporates measurements from multiple criteria. Each criterion has several alternatives that can be used to find a solution, and to find a suitable alternative, the value of each alternative is multiplied by a predetermined priority. As a result, the outcome or best value of the alternatives will be chosen as a solution. MAUT is a multi-attribute decision-making method that provides a framework for combining various objectives and uncertainties to aid decision-making in portfolio assessments involving multiple criteria [7].

The MAUT method is also used to assess personal values. The value used as analysis input is derived from the scoring results based on Holland's personality theory. The output is a personality rating of prospective students based on the dominant personality's suitability for each study program. The input values derived from the interest test and academic tests have been stated in the appropriate range so that the scores can be used directly for the final analysis.

Several studies have been conducted regarding the decision support system for recruitment using the MAUT method. The use of MAUT for employee recruitment in companies can provide an accuracy of 93.33% by comparing the assessment results with the old system. The criteria used are administrative, psychological, interview, and health tests [8]. MAUT can also be used to assess the best performance of an employee [9], [10]. This research can rank employees with the best performance based on the final result of the MAUT score. Research on the comparison of MAUT and TOPSIS methods in determining Bidik Misi scholarship recipients was carried out on 150 data. The MAUT method can produce an accuracy of 94.667%, while the TOPSIS method only produces an accuracy of 48% [11]. MAUT theory can also be used to determine the best performance benchmarking in a study class [12]. A strong advantage of using MAUT for this research is its ability to consider all important metrics and determine the best overall performance for this data. In addition, MAUT allows the comparison of different types of data to be compared directly. In the business field, MAUT can also support a decision, for example, choosing a co-branding partner [13]. Decision-makers sometimes face a dilemma in selecting a good co-branding partner. The wrong decision will fail the operation and increase the negative brand image. This study determined the best co-branding partner based on the MAUT method. Research on the selection of wall systems for offices can also be carried out using the MAUT method [10]. Some of the categories used include material weight, wind resistance, fire resistance, economic value, etc. All of these categories will result in a decision to determine the best material according to the preferences of the office owner. MAUT is also used for selecting diplomats. The results of testing 50 sample data to calculate the selection of foreign diplomats using the MAUT method were 94% [14]. MAUT can also be used to evaluate the design of low-density

residential units to increase the company's profits from a particular design, by assessing changes in market share as a result of the attributes of the units being built [15]. In another case, MAUT is used to categorize railway embankments in order to prioritize maintenance activities. The model's results can be used as a support for the decision-making process for maintenance planning [16].

**Table 1. Literature of Study**

| | Previous Study | Strengths | Weakness |
|---|---|---|---|
| 1. | Decision Support System for Employee Recruitment of A Company Using Multi-Attribute Utility Theory. | MAUT for company employee recruitment can provide an accuracy of 93.33% by comparing the assessment results with the old system. | The MAUT method is very dependent on giving weight to each criterion, so it requires a rubric that has been analyzed according to the decision-maker |
| 2. | Comparison of two methods between TOPSIS and MAUT in determining BIDIKMISI scholarship. | The MAUT method can produce an accuracy of 94.667%. | |
| 3. | The use of multi-attribute utility theory to determine the overall best-in-class performer in a benchmarking study. | A strong advantage of using MAUT for this research is its ability to consider all important metrics and determine the best overall performance for this data. | |
| 4. | Implementation of Multi-Attribute Utility Theory (MAUT) method for selecting diplomats. | Based on testing 50 sample data to calculate the selection of foreign diplomats using the MAUT method, the results were 94%. | |
| 5. | An application of Multi-Attribute Utility Theory (MAUT) to the prioritization of rural roads to improve rural accessibility in Nigeria | The result recommends that decision-makers adopt a similar approach in selecting rural roads for an upgrade instead of selecting roads based on political considerations | |

MAUT method is used to prioritize rural roads to improve rural accessibility. The result recommends that decision-makers adopt a similar approach in selecting rural roads for an upgrade, instead of selecting roads based on political considerations [17], and to satisfy the requirements of high energy density, high power density, quick response, and long lifespan for energy storage systems (E.S.S.s). MAUT method has significant advantages in solving the incommensurability and contradiction among multiple attributes [18]. From several examples of research that has been carried out, it can be seen that the MAUT method is flexible and can be used in various fields to support a decision. Table 1 shows some of the literature on the study.

## 2. Method

The MAUT method is also used to assess personal values. The value used as analysis input is derived from the scoring results based on Holland's personality theory. The output is a personality rating of prospective students based on the dominant personality's suitability for each study program. The input values derived from the interest test and academic tests have been stated in the appropriate range so that the scores can be used directly for the final analysis. The data search in the literature study was done by looking

for references in many books and journals related to decision support systems using the MAUT method. This method of data collection also makes use of internet media.

This system's system development method is a spiral, evolutionary software process model that combines an iterative prototyping approach with controlled aspects in the waterfall model. The spiral model allows rapid software development, progressing from less complete software versions to more complete ones [19]. This study's spiral model process has four stages: communication, planning, modeling, and construction.

Communication is the first stage to identify problems that arise later, and then the system's needs are formulated. Estimates of the costs required to manufacture software, scheduling system creation time, and software risk analysis are performed during the planning stage. The stages of modeling, analysis, and system design are completed, and the decision model analysis employs the MAUT method. Data flow diagrams (DFD), entity relationship diagrams (E.R.D.), flow charts, and interfaces define system analysis. Furthermore, the system design is defined using the database structure, table relationships, and a data dictionary. Then, during the construction stage, coding and testing are performed on the system that has been built.

The final evaluation scheme V(x) of an object x, defined as the weight added to the value relevant to the criterion value, is Multi-Attribute Utility Theory (MAUT). MAUT is used to convert multiple criteria to a numeric value on a scale of 0 to 1, with 0 representing the worst option and 1 representing the best. MAUT is based on using a utility function to measure decision makers' preferences by assigning a numerical index to different levels of satisfaction [20].

This method is based on the value of each alternative in terms of the decision maker's preferences, which can be identified by breaking down the decision into things of value, measuring the value provided by each available alternative, and measuring the value of a function that includes attribute performance measures and weights that reflect the interests and scale [21].

Figure 1 depicts the calculation steps in the MAUT method for analyzing the portfolio value of prospective teacher students:

- Break the decision down into different criteria.
- For each criterion, determine the normalization criteria.

$$w_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \tag{1}$$

Furthermore, if the total weight of the criteria is added up, the normalized criterion weight is 1 (one).

$$\sum_{i=1}^{n} w_i = 1 \tag{2}$$

w_i = $i^{th}$ criterion weight

n = number of criteria

i = criteria

- Make a list of all possible solutions.
- Determine the matrix normalization value for each alternative based on its characteristics.

$$U(x) = \frac{(x - x^{-})}{(xi^{+} - xi^{-})} \quad (3)$$

$U(x)$ = normalization from alternative weight
$xi^{-}$ = minimum weight criteria
$xi^{+}$ = maximum weight criteria
$x$ = alternative weight

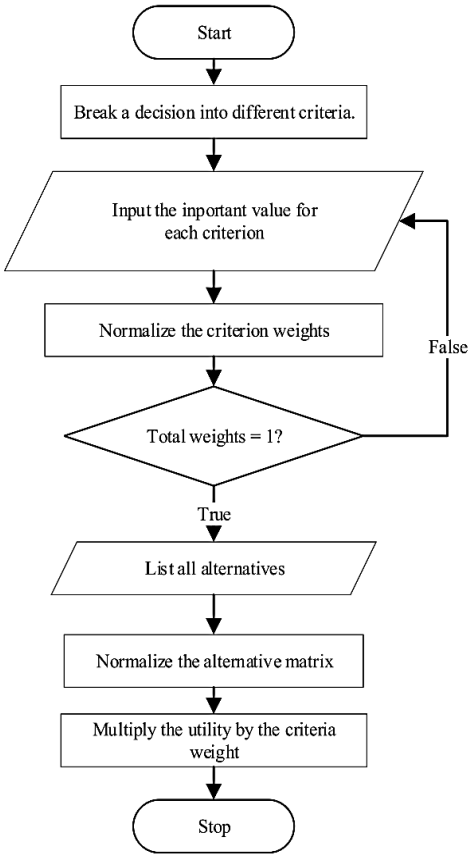


*Figure 1.* Flowchart of MAUT calculation

• To determine the value of each alternative, multiply the utility by its weight.

$$V(x) = \sum_{i=1}^{n} w_i U(x) \quad (4)$$

$V(x)$ = evaluation weight
$n$ = criteria number
$i$ = criteria
$w_i$ = i$^{th}$ criterion weight
$U(x)$ = utility function value at ith criterion
$x$ = alternative

The phases of the MAUT method can be seen in Figure 1.Furthermore, the Min-Max Scaling method was used to assess personality. The personality tests using Holland's personality type were used to derive personality values. According to the personality criteria, there are six input values: realistic, investigative, artistic, social, enterprising, and conventional. The six generated values have a range of values that vary depending on the number of questions asked for each personality type. A balance of values scaled from 0 to 1 can be obtained by using Min-Max Scaling [22]. The Min-Max Scaling method's formula is as follows:

$$x' = \frac{x - x_{min}}{x_{min} - x_{max}} \tag{5}$$

$x$ = initial value before normalization

$x'$ = normalization value

$x_{min}$= minimum value

$x_{max}$= maximum value

The proposed idea is to use the MAUT stratified method to obtain the final analysis because this study consists of several main categories accompanied by sub-categories. Multi-level MAUT is the name we gave to the proposed method.

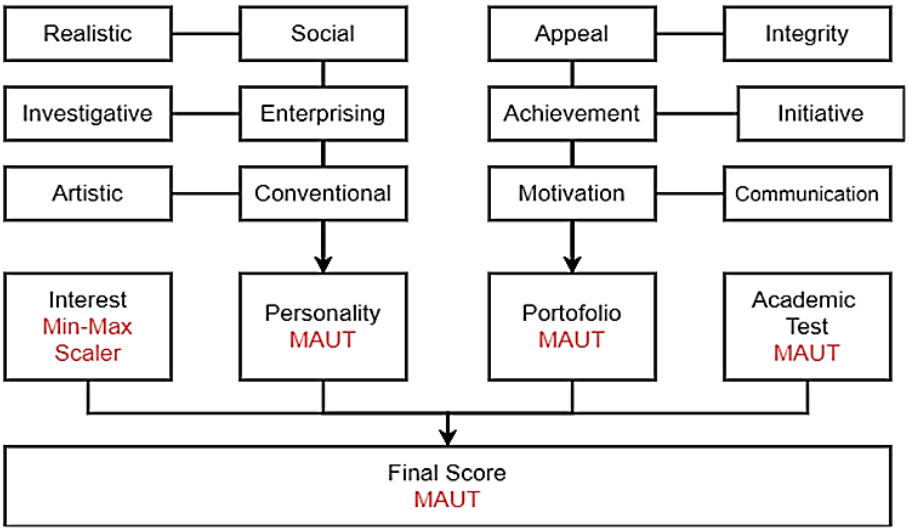


*Figure* 2. Structure of Categories and Sub-categories of Multilevel MAUT

Figure 2 depicts the application of Multilevel MAUT, demonstrating how the MAUT method is used in categories with sub-categories. It aims to process multidimensional data to be worked on in a single dimension to produce a single final value. Several sub-categories within the personality category include realistic, investigative, artistic, social, enterprising, and conventional.

In the interest assessment, the score ranges from 0 to 130, according to the rubric. Furthermore, the min-max scaler technique is used for normalization to convert the range of values to a scale of 0 to 1. The personality value consists of 6 personality components based on Holland's theory. The six personality types were analyzed using the MAUT method. However, not all personality values will be used, and only personality values correspond to the department in which prospective teacher students apply.

The novelty we proposed in this study was that we combined several assessment components with rubrics that had been previously analyzed and tested. Then each

component of the assessment will be ranked using the MAUT method. Then the MAUT score results in each assessment component at the final stage will be used again by the MAUT method to analyze the final results. We used the multi-level MAUT approach in the final analysis.

Moreover, Holland's theory is used to help make promising career choices and requires the determination of coefficients that describe individuals and their (potential) work environments [23]–[25]. Based on Holland's personality theory, sub-categories in the main personality categories were obtained. Meanwhile, the primary portfolio category is divided into several sections: appearance, achievement, motivation, integrity, initiative, and communication [26]–[30].

## 4. Result and Discussion

To conclude, the final analysis of the built decision support system includes four critical components. These components include interest, academic ability, personality, and portfolio test scores. There is no further data processing in assessing academic interest and ability because the input value data is ready for final score analysis. In contrast to portfolio and personality values, it is necessary to conduct an analysis first due to the various value ranges that must be balanced for them to be accumulated in the final score analysis to determine the rank of prospective teacher students. The portfolio component in the case study has six criteria to be tested, as shown in Table II.

**Table 2. Portofolio Criteria and Weight**

| Code | Criteria | Weight |
|---|---|---|
| C1 | Appeal | 6 |
| C2 | Achievement | 8 |
| C3 | Motivation | 7 |
| C4 | Integrity | 8 |
| C5 | Initiative | 8 |
| C6 | Communication | 9 |
| | Total | 46 |

Each criterion in Table 2 has a significant value based on interviews with stakeholders. Appearance criteria are used to assess how attractive prospective teacher students are. Achievement criteria are used to assess accomplishments at the local, regional, and international levels. Motivation criteria are used to assess how far prospective students' motivation to become teachers has progressed. Integrity criteria are used to assess values, principles, and consistency.

**Table 3. Weight Criteria Normalization**

| Code | Criteria | Weight | Normalization |
|---|---|---|---|
| C1 | Appeal | 6 | 6/46 = 0,130434783 |
| C2 | Achievement | 8 | 8/46 = 0,173913043 |
| C3 | Motivation | 7 | 7/46 = 0,152173913 |
| C4 | Integrity | 8 | 8/46 = 0,173913043 |
| C5 | Initiative | 8 | 8/46 = 0,173913043 |
| C6 | Communication | 9 | 9/46 = 0,195652174 |
| | Total | 46 | 1 |

Initiative criteria are used to assess prospective students' ability to take the initiative or make a decision. Communication criteria to assess prospective student teachers' verbal and nonverbal communication skills.

The first step is to normalize the weight criteria. Six criteria are used in the portfolio assessment metric, as previously described. The weights assigned to each criterion are determined by assessment experts who serve as stakeholders in the recruitment system. Normalization is performed on each weight criterion to be scaled from a range of values ranging from 0 to 1 and used in the next stage.

**Table 4. Portfolio value from Student as Teacher Candidates**

| Code | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| P1 | 100 | 125 | 100 | 100 | 100 | 100 |
| P2 | 100 | 100 | 100 | 90 | 90 | 90 |
| P3 | 100 | 90 | 90 | 80 | 100 | 100 |
| P4 | 90 | 95 | 100 | 100 | 80 | 90 |
| P5 | 80 | 110 | 95 | 90 | 100 | 90 |
| P6 | 90 | 85 | 100 | 90 | 80 | 80 |
| P7 | 100 | 90 | 80 | 100 | 90 | 70 |
| P8 | 90 | 85 | 95 | 70 | 100 | 80 |
| P9 | 100 | 90 | 100 | 90 | 90 | 90 |
| P10 | 75 | 85 | 100 | 80 | 100 | 100 |

Table 4 shows input value examples for the six portfolio criteria. The criteria for appearance, motivation, integrity, initiative and communication use a scale of 0 to 100, whereas achievement uses a scale with no definite limits. The higher the level of achievement and the number of certificates obtained by a teacher candidate, the greater the value obtained by the participant.

**Table 5. Normalization value portfolio result**

| Code | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| P1 | 1 | 1 | 1 | 1 | 1 | 1 |
| P2 | 1 | 0,375 | 1 | 0,667 | 0,5 | 0,6667 |
| P3 | 1 | 0,125 | 0,5 | 0,333 | 1 | 1 |
| P4 | 0,6 | 0,25 | 1 | 1 | 0 | 0,6667 |
| P5 | 0,2 | 0,625 | 0,75 | 0,667 | 1 | 0,6667 |
| P6 | 0,6 | 0 | 1 | 0,667 | 0 | 0,333 |
| P7 | 1 | 0,125 | 0 | 1 | 0,5 | 0 |
| P8 | 0,6 | 0 | 0,75 | 0 | 1 | 0,333 |
| P9 | 1 | 0,125 | 1 | 0,667 | 0,5 | 0,667 |
| P10 | 0 | 0 | 1 | 0,333 | 1 | 1 |

The next step is to normalize the value of the input portfolio. This is done to homogenize values so that previously different ranges of values can be scaled to a range of 0 to 1. There is one portfolio criterion, achievement, that does not have a definite value limit. As a result of normalization, all of the criteria in the portfolio evaluation are converted to have a maximum value of 1 and a minimum value of 0. After obtaining the normalization results on the criteria weights and normalization on the input values, the multiplication process is applied to these values, yielding MAUT scores for portfolio assessment. The same is true for personality traits. The MAUT method was used to assess personality values. The following is an example of personality input values, which are divided into six categories: realistic (R), investigative (I), artistic (A), social (S), enterprising (E), and conventional (C).

**Table 6. Normalization value portfolio result**

| Code | C1 | C2 | C3 | C4 | C5 | C6 | Total |
|---|---|---|---|---|---|---|---|
| P1 | 0,130 | 0,174 | 0,152 | 0,174 | 0,174 | 0,196 | 1 |
| P2 | 0,130 | 0,065 | 0,152 | 0,116 | 0,087 | 0,130 | 0,681 |
| P3 | 0,130 | 0,022 | 0,076 | 0,058 | 0,174 | 0,196 | 0,656 |
| P4 | 0,078 | 0,043 | 0,152 | 0,174 | 0 | 0,130 | 0,578 |
| P5 | 0,026 | 0,109 | 0,114 | 0,116 | 0,174 | 0,130 | 0,669 |
| P6 | 0,078 | 0 | 0,152 | 0,116 | 0 | 0,065 | 0,412 |
| P7 | 0,130 | 0,022 | 0 | 0,174 | 0,087 | 0 | 0,413 |
| P8 | 0,078 | 0,000 | 0,114 | 0 | 0,174 | 0,065 | 0,432 |
| P9 | 0,130 | 0,022 | 0,152 | 0,116 | 0,087 | 0,130 | 0,638 |
| P10 | 0 | 0 | 0,152 | 0,058 | 0,174 | 0,196 | 0,580 |

**Table 7. Personality value of Student as Teacher Candidates**

| Code | R | I | A | S | E | C |
|---|---|---|---|---|---|---|
| P1 | 150 | 130 | 120 | 140 | 130 | 100 |
| P2 | 90 | 110 | 140 | 135 | 150 | 90 |
| P3 | 130 | 90 | 90 | 80 | 100 | 100 |
| P4 | 110 | 95 | 100 | 100 | 80 | 90 |
| P5 | 90 | 110 | 95 | 90 | 100 | 90 |
| P6 | 140 | 85 | 100 | 90 | 80 | 80 |
| P7 | 125 | 90 | 80 | 100 | 90 | 70 |
| P8 | 140 | 85 | 95 | 70 | 100 | 80 |
| P9 | 130 | 100 | 90 | 100 | 130 | 120 |
| P10 | 80 | 120 | 130 | 160 | 140 | 110 |

Testing Holland's personality theory [12] yields the personality input value. This value is the sum of the values assigned to each question item representing a different personality type. Not all personality type values are used to determine prospective teacher students' graduation. This study used two personality types based on the recommended personality type for the intended study program. Experts who are also

stakeholders in the recruitment process provide references for determining recommendations for personality types following the study program. For example, the Computer Engineering study program uses realistic (R) and investigative (I) personality types.

**Table 8. Criteria and Weight of Personality**

| Code | Criteria | Bobot |
|---|---|---|
| K1 | Personality 1 | 10 |
| K2 | Personality 2 | 6 |
| | Total | 16 |

In Table 8, a weight ratio of 10:6 is used between Personality 1 and Personality 2.

**Table 9. Weight Criteria Normalization**

| Code | Criteria | Weight | Normalization |
|---|---|---|---|
| K1 | Personality 1 | 10 | 10/16 = 0,625 |
| K2 | Personality 2 | 6 | 6/16 = 0,375 |
| Total | | 16 | 1 |

The weight criteria are then normalized to a scale with values ranging from 0 to 1. This normalization is also required because the scoring will be determined by the number of questions available to test each personality type, with no reference to the maximum range of values.

**Table 10. Personality Value Normalization Result**

| Code | R | I |
|---|---|---|
| P1 | 1 | 1 |
| P2 | 0,143 | 0,556 |
| P3 | 0,714 | 0,111 |
| P4 | 0,429 | 0,222 |
| P5 | 0,143 | 0,556 |
| P6 | 0,857 | 0 |
| P7 | 0,643 | 0,111 |
| P8 | 0,857 | 0 |
| P9 | 0,714 | 0,333 |
| P10 | 0 | 0,778 |

Table 10 shows an example of the results of normalizing the input of normalized personality values. The MAUT score from the personality assessment is calculated in the same way by multiplying the normalization value of the personality weight criteria by the normalized value of the personality input.

**Table 11. Personality And Weight Value Multiplication Result**

| Code | R | I | Total |
|---|---|---|---|
| P1 | 0,625 | 0,375 | 1 |
| P2 | 0,089 | 0,208 | 0,298 |
| P3 | 0,446 | 0,042 | 0,488 |
| P4 | 0,268 | 0,083 | 0,351 |
| P5 | 0,089 | 0,208 | 0,298 |
| P6 | 0,536 | 0 | 0,536 |
| P7 | 0,402 | 0,042 | 0,443 |
| P8 | 0,536 | 0 | 0,536 |
| P9 | 0,446 | 0,125 | 0,571 |
| P10 | 0 | 0,292 | 0,292 |

The final analysis can be calculated after obtaining the value of the portfolio and personality analysis results. The MAUT method is also used in the final value analysis. Interest, personality, academic, and portfolio test scores are the four components used.

Table 11 shows some examples of input values for the final analysis. It shows that the value of interest is represented by 1 or 0, where 1 indicates interest and 0 indicates disinterest. Furthermore, the personality value is derived from the previous MAUT score calculation results. Academic scores are calculated from computer-based test scores with a value range of 0-100, so they can be used directly without being processed first. The portfolio value is the MAUT score obtained in the previous stage. The four main criteria for determining the final score are interest, personality, academics, and portfolio. The MAUT algorithm is used to calculate the final score. We named the method Multilevel MAUT because MAUT is used on multiple levels. The MAUT method is used first in the main sub-categories and then continued in the main category.

**Table 12. Input Value of Final Result Analysis**

| Code | Interest | Personality | Academic | Portfolio |
|---|---|---|---|---|
| P1 | 1 | 1 | 0,98 | 1 |
| P2 | 1 | 0,298 | 0,85 | 0,681 |
| P3 | 0 | 0,488 | 0,90 | 0,656 |
| P4 | 1 | 0,351 | 0,83 | 0,578 |
| P5 | 1 | 0,298 | 0,75 | 0,669 |
| P6 | 1 | 0,536 | 0,79 | 0,412 |
| P7 | 0 | 0,443 | 0,88 | 0,413 |
| P8 | 0 | 0,536 | 0,93 | 0,432 |
| P9 | 1 | 0,571 | 0,78 | 0,638 |
| P10 | 0 | 0,292 | 0,86 | 0,580 |

The weighting and normalization of the main categories are shown in Table 13. The weights used in the assessment are based on expert references who also serve as stakeholders.

**Table 13. Normalization of Weight Criteria**

| Code | Criteria | Weight | Normalization |
|---|---|---|---|
| A1 | Interest | 3 | 3/25 = 0,12 |
| A2 | Personality | 5 | 5/25 = 0,2 |
| A3 | Academic | 10 | 10/25 = 0,4 |
| A4 | Portfolio | 7 | 7/25 = 0,28 |
| | Total | 25 | 1 |

After normalizing the weights, then proceed to the multiplication process between the normalization of the weight criteria and the input value criteria to get the MAUT score.

**Table 14. Value by Weight Multiplication**

| Code | A1 | A2 | A3 | A4 | Total |
|---|---|---|---|---|---|
| P1 | 0,12 | 0,2 | 0,392 | 0,28 | 0,992 |
| P2 | 0,12 | 0,06 | 0,34 | 0,191 | 0,71 |
| P3 | 0 | 0,098 | 0,36 | 0,184 | 0,641 |
| P4 | 0,12 | 0,07 | 0,332 | 0,162 | 0,684 |
| P5 | 0,12 | 0,06 | 0,3 | 0,187 | 0,667 |
| P6 | 0,12 | 0,107 | 0,316 | 0,115 | 0,659 |
| P7 | 0 | 0,089 | 0,352 | 0,116 | 0,556 |
| P8 | 0 | 0,107 | 0,372 | 0,121 | 0,6 |
| P9 | 0,12 | 0,114 | 0,312 | 0,179 | 0,725 |
| P10 | 0 | 0,058 | 0,344 | 0,162 | 0,565 |

The final stage is to rank after receiving the MAUT score in the final assessment. Table 15 shows an example of passing grades sorted by final MAUT score in Table 14.

**Table 15. Student Graduation Ranking of Teacher Candidate**

| Code | Final Score |
|---|---|
| P1 | 0,992 |
| P9 | 0,725 |
| P2 | 0,71 |
| P4 | 0,684 |
| P5 | 0,667 |

| Code | Final Score |
|---|---|
| P6 | 0,659 |
| P3 | 0,641 |
| P8 | 0,6 |
| P10 | 0,565 |
| P7 | 0,556 |

## 5. Conclusions and Suggestion

Based on the analysis results, the algorithm that has been applied and tested can rank prospective students' selection for teacher recruitment in the system using four assessment indicators: interests, personality, academic tests, and portfolios. The ranking is ordered based on the multi-level MAUT analysis, where the MAUT results from all components of the assessment indicator are accumulated using the MAUT method for the final score. We also combine the Min-Max Normalization method to scale non-category values, especially interest values, so that the final result can be analyzed with an output value of 0 to 100.

**Author Contributions:** Conceptualization, methodology, validation, formal analysis, investigation, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision, project administration, funding acquisition; Muharram [M], Bakhrani A. Rauf [B.A.R], Muhammad Agung[M.A], Yohandri[Y], Baharuddin[B], I Nyoman Sila [I.N.S], Suyanta [S], Usman Mulbar [U.M], Abdul Wahid [A.W], Jumadi M. Parenreng [J.M.P], Abdul Saman [A.S], Yasdin [Y], Amirullah Abduh [A.A], Muhammad Fajar B [M.F.B], M. Syahid Nur Wahid [S.N.W], have read and agreed to the published version of the manuscript.

**Acknowledgments:** This research was funded by the Directorate General of Research and Development Strengthening, Ministry of Research, Technology and Higher Education number S.P. DIPA-042.06.1.401516 / 2019, December 05, 2018. Research contracts for 2019 National Strategy Leading Research multi-years: 2019, 2020 and 2021 with number: 119 / UN36.11 / LP2M / 2019.

**Conflicts of Interest**: The authors declare no conflict of interest.

## References

1. Suyanta, A. R. P. Sari, S. Astuti, and R. Tyas, "Educational LPTK, Non-educational LPTK, and Non-LPTK Students' Intention to Become Teacher," Univers. J. Educ. Res., vol. 8, pp. 6676–6683, Dec. 2020, doi: 10.13189/ujer.2020.081232.
2. A. L. Felix, J. Z. Bandstra, and W. H. J. Strosnider, "Design-Based Science for STEM Student Recruitment and Teacher Professional Development," Fall 2010 Mid-Atlantic ASEE Conf., 2010.
3. R. M. Klassen and L. E. Kim, "Selecting teachers and prospective teachers: A meta-analysis," Educ. Res. Rev., vol. 26, pp. 32–51, 2019, DOI: 10.1016/j.edurev.2018.12.003.
4. F. Sun and Y. Ma, "College Teachers' Soft Ability Indicator System and Measuring Methods," pp. 277–283, 2019, DOI: 10.4236/jhrss.2019.72017.
5. A. Adak Özdemir and B. Özdemir Beceren, "The Role of the Professional Characteristics of Teachers in the Context of the General Qualifications of the Teaching Profession," Educ. Policy Anal. Strateg. Res., vol. 13, no. 4, pp. 70–90, 2018, doi: 10.29329/epasr.2018.178.4.

6. S. M. Mohammed, "Teachers' Beliefs: Positive or Negative Indicators of Inquiry-Based Science Teaching?," World J. Educ., vol. 12, no. 1, p. 17, 2022, DOI: 10.5430/wje.v12n1p17.
7. D. Danesh, M. Ryan, and A. Abbasi, "A systematic comparison of multi-criteria decision-making methods for the improvement of project portfolio management in complex organizations," Int. J. Manag. Decis. Mak., vol. 16, p. 280, Jan. 2017, doi: 10.1504/IJMDM.2017.085638.
8. M. Mihuandayani, R. Arundaa, and V. Tamuntuan, "Decision Support System for Employee Recruitment of A Company Using Multi-Attribute Utility Theory," in 2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS), 2020, pp. 1–6. DOI: 10.1109/ICORIS50180.2020.9320817.
9. H. Gunawan and H. Ramadhan, "Increased Accuracy of Selection High Performing Employees Using Multi-Attribute Utility Theory (MAUT)," 2018 6th Int. Conf. Cyber I.T. Serv. Manag. CITSM 2018, no. CITSM, pp. 2018–2021, 2019, DOI: 10.1109/CITSM.2018.8674060.
10. D. Maharani and M. Sena, Dwi, "the Mfep and Maut Methods in Selecting the Best Employees," Int. Conf. Soc. Sci. Inf. Technol., vol. 4509, no. 1, pp. 1–7, 2020.
11. Ramadiani, H. R. Hatta, N. Novita, and Azainil, "Comparison of two methods between TOPSIS and MAUT in determining BIDIKMISI scholarship," Proc. 3rd Int. Conf. Informatics Comput. ICIC 2018, 2018, DOI: 10.1109/IAC.2018.8780455.
12. T. R. Collins, M. D. Rossetti, H. L. Nachtmann, and J. R. Oldham, "The use of multi-attribute utility theory to determine the overall best-in-class performer in a benchmarking study," Benchmarking, vol. 13, no. 4, pp. 431–446, 2006, DOI: 10.1108/14635770610676281.
13. W. L. Chang, "Using multi-attribute utility theory to rank and select co-branding partners," Proc. - 8th Int. Conf. Intell. Syst. Des. Appl. ISDA 2008, vol. 1, no. 1, pp. 195–200, 2008, DOI: 10.1109/ISDA.2008.220.
14. I. Taufik, C. N. Alam, Z. Mustofa, A. Rusdiana, and W. Uriawan, "Implementation of Multi-Attribute Utility Theory (MAUT) method for selecting diplomats," I.O.P. Conf. Ser. Mater. Sci. Eng., vol. 1098, no. 3, p. 032055, 2021, DOI: 10.1088/1757-899x/1098/3/032055.
15. S. BuHamdan, A. Alwisy, A. Bouferguene, and M. Al-Hussein, "The application of multi-attribute utility theory for a market share-based design evaluation," Int. J. Hous. Mark. Anal., vol. 12, no. 6, pp. 985–1003, 2019, doi: 10.1108/IJHMA-11-2018-0087.
16. M. S. Kovacevic, M. Bacic, I. Stipanovic, and K. Gavin, "Categorization of the condition of railway embankments using a multi-attribute utility theory," Appl. Sci., vol. 9, no. 23, 2019, DOI: 10.3390/app9235089.
17. U. Akpan and R. Morimoto, "An application of Multi-Attribute Utility Theory (MAUT) to the prioritization of rural roads to improve rural accessibility in Nigeria," Socioecon. Plann. Sci., no. July 2021, p. 101256, 2022, DOI: 10.1016/j.seps.2022.101256.
18. X. Feng, J. Gu, and X. Guan, "Optimal allocation of hybrid energy storage for microgrids based on multi-attribute utility theory," J. Mod. Power Syst. Clean Energy, vol. 6, no. 1, pp. 107–117, 2018, DOI: 10.1007/s40565-017-0310-3.
19. R. S. Pressman, Software Quality Engineering: A Practitioner's Approach, vol. 9781118592. 2014. DOI: 10.1002/9781118830208.
20. N. Singh and P. Bhargava, "Multi-Attribute Utility Theory (MAUT) Driven New Product Development Using Multi-Criteria Decision Making (MCDM)," Int. J. Eng. Trends Technol., vol. 67, pp. 27–30, May 2019, DOI: 10.14445/22315381/IJETT-V67I5P205.
21. M. Shanmuganathan, K. Kajendran, A. N. Sasikumar, and M. Mahendran, "Multi Attribute Utility [21]M. Shanmuganathan, K. Kajendran, A. N. Sasikumar, and M. Mahendran, "Multi Attribute Utility Theory – An Over View," Int. J. Sci. Eng. Res., vol. 9, no. 3, pp. 698–706, 2018.

22. H. Henderi, "Comparison of Min-Max normalization and Z-Score Normalization in the K-nearest neighbor (kNN) Algorithm to Test the Accuracy of Types of Breast Cancer," IJIIS Int. J. Informatics Inf. Syst., vol. 4, no. 1, pp. 13–20, 2021, doi: 10.47738/ijiis.v4i1.73.
23. F. Hartmann, J.-H. Heine, and B. Ertl, "Concepts and Coefficients Based on John L. Holland's Theory of Vocational Choice—Examining the R Package holland," Psych, vol. 3, no. 4, pp. 728–750, 2021, DOI: 10.3390/psych3040047.
24. Y. Ayriza, A. Triyanto, F. A. Setiawati, and N. E. Gunawan, "Exploring children's career interests and knowledge based on holland's theory," Int. J. Instr., vol. 13, no. 4, pp. 643–662, 2020, doi: 10.29333/iji.2020.13440a.
25. S. B. Khan, S. A. Alvi, N. Shaukat, M. A. Hussain, and T. Baig, "A study of the validity of Holland's theory in a non-western culture," J. Vocat. Behav., vol. 36, no. 2, pp. 132–146, 1990, DOI: https://doi.org/10.1016/0001-8791(90)90021-S.
26. R. Hendra, N. Sridana, and M. Muntari, "Implementation of Teacher Professionalism Recruitment in S.M.K. NW Wanasaba," Int. J. Soc. Sci. Res. Rev., vol. 5, no. 2, pp. 37–45, 2022, doi: 10.47814/ijssrr.v5i2.167.
27. G. Sang, J. C. Liang, C. S. Chai, Y. Dong, and C. C. Tsai, "Teachers' actual and preferred perceptions of twenty-first-century learning competencies: a Chinese perspective," Asia Pacific Educ. Rev., vol. 19, no. 3, pp. 307–317, 2018, DOI: 10.1007/s12564-018-9522-0.
28. D. J. Kelm et al., "Characteristics of Effective Teachers of Invasive Bedside Procedures: A Multi-institutional Qualitative Study," Chest, vol. 158, no. 5, pp. 2047–2057, 2020, DOI: 10.1016/j.chest.2020.04.060.
29. A. Reyes et al., "Across Generations: Defining Pedagogical Characteristics of Generation X, Y, and Z Allied Health Teachers Using Q-Methodology," Med. Sci. Educ., vol. 30, no. 4, pp. 1541–1549, 2020, DOI: 10.1007/s40670-020-01043-7.
30. Umar, P. Setyosari, W. Kamdi, and Sulton, "Exploration of Moral Integrity Education and Superior Cadre Leadership at Madrasah Boarding School Indonesia," Int. J. Instr., vol. 14, no. 4, pp. 753–774, 2021.