Decision support system for considering the best teacher performance using MOORA method

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Abstract. Islamic Boarding School is a school where students stay, live and study about formal educations and Islamic religion educations in the dormitory. The best teacher performance in Islamic boarding school is assessed using two competences, hard and soft competency. Each of these competences has many criteria. The assessment is conducted in every semester. The assessment aims to support and improve the quality of teacher’s performance because its result become as baseline to determine incentive level and warning letter for teachers. These assessments can lead tedious, human error and subjectively decision. To avoid the wrong decision, it is necessary a decision support system for helping to decide the best teacher performance. This application was using Multi Objective Optimization method on the Basis of Ratio Analysis (MOORA). This research produced a web-based decision support system that was used to help decision maker to decide the best teacher performance.

Keywords—Islamic boarding school, MOORA, teacher’s performance, decision support system.

1. Introduction

Islamic Boarding School is a school where students stay and live in the dormitory. The students get more lessons here than in general school. They get both of formal educations and Islamic religion lessons. The teachers in Islamic Boarding School interact with the students intensively, not only in the classroom while they are studying, but also in the mosque or dormitory while they are praying together. Refer to [1], the teaching professions need to be improved and developed constantly according to the functional position of teachers. It is necessary to assess teacher’s performance whose guarantee a quality learning process at all levels of education.

The quality of teacher performance in the Islamic Boarding School is not only assessed through their teaching abilities, but also their attitude and daily spiritual activities outside the classroom. The assessment aim to support and improve the quality of teacher’s performance because its result became as baseline to determine incentive level and warning letter for teachers. The research whose is conducted by [2], used WP method and 10 criteria. But, this research isn’t used and calculated for daily activities of teachers in dormitory and mosque.

In this assessment, the instruments consist of soft and hard competency. There are 23 criteria that used in this research. Filling out the assessment manually can lead tedious, human error and subjectively assessment. The files required in carrying out the assessment are vulnerable to loss, scattering or corrupted. The calculation process manually can spend long time, it’s about 1 month and get subjective
result, while using the system, the calculation process are just spending a little bit time and get objective result.

Based on the problems, it is necessary to build a decision support system to help the process of deciding the best teacher performance. This system uses Multi Objective Optimization on the Basis of Ratio Analysis (MOORA) method. The MOORA method has a degree of flexibility and ease of understanding in separating the subjective part of an evaluation process into the decision-making criteria with some decision-making attributes [3]. The result of this system shows the ranking of the best teacher performance.

2. Literature Review

2.1. Decision Support System

Decision Support Systems (DSS) is the methodology to support decision-making on the semi-structured and unstructured problems. DSS is using user interface, usually web-based to communicate with the user. DSS calculates the data using specific model or method and join the thought of the decision maker [4]. Refer to [5] [6] [7] [8] [9], DSS combines management science, operational research, control theory and behavioral science with simulation using computer and information technology and those system are widely used in any environments, including business, health, education, logistics, transportation, manufacturing, etc.

There are four phases in a decision-making process according to Simon model in the figure 1.

![Figure 1. The Phases of the Decision-Making Process [4].](image)

In intelligence phase, goals and objectives are the defined related problems. Output of the first phase is the problem statement. The second phase is design, where developing, testing and validating decision-making model. Outputs of this phase are criteria and alternatives. The third phase is choice, it is a phase of searching, evaluating and recommending the suitable solutions of the problem. Output of this phase is evaluation result and consideration of the model testing. The fourth phase is implementation, which consist of putting the selected solution to take action for solving the problem [4].

The main components that build a decision support system, are [10] database/document base; knowledge-based; model of the decision support; communication; and user interface.

2.2. MOORA Method

MOORA is a method introduced by Brauers and Zavadkas and it is relatively new. This method was first used in multi-criteria decision-making by Brauers [3]. The MOORA method consists of five main steps as described below [3]

1. Defines the objectives and identify the attributes of the evaluation in question.
2. Displays all information in the form of a decision x matrix that can be represented as follows

   \[ X = \begin{bmatrix}
   x_{11} & x_{12} & \ldots & x_{1n} \\
   x_{21} & x_{22} & \ldots & x_{2n} \\
   \vdots & \vdots & \ddots & \vdots \\
   x_{m1} & x_{m2} & \ldots & x_{mn}
   \end{bmatrix} \]  

   \hspace{1cm} (1)

   Where \( x_{ij} \) is the performance measure of the \( j \)-th alternative on \( j \)-th attribute, \( m \) is the number of alternatives and \( n \) is the number of attributes.

3. Normalized matrix by using the following formula:

   \[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \]  

   \hspace{1cm} (2)
Where \( x_{ij} \) is the response of alternative \( j \) on objective \( i; j=1, 2, ..., m; m \) the number of alternatives; \( i =1, 2, ..., n; n \) the number of objectives; \( r_{ij} \) is a dimensionless number representing the response alternative \( j \) on objective \( i \).

4. Optimize the objective value of \( y_i \) by using the following formula:

\[
y_i = \sum_{j=g+1}^{n} x_{ij} - \sum_{j=1}^{g} x_{ij}
\]

with \( g \) is the value of the criteria to be maximized, \( n \) is the value of the criteria to be minimized, and \( y_i \) is the value of the normalized value, \( w \) is the weight of \( j \) attribute.

5. Rank based on the value of \( y_i \). The \( y_i \) value can be either positive or negative depending on the maximum number (the favorable criteria) and the minimum amount (the unfavorable criteria) in the decision matrix.

2.3. Competences of The Best Teacher Performance

The criteria to decide the best performance teacher in Islamic Boarding School consist of hard and soft competency. The Hard competency related to the teachers activity in the learning process in the classroom. The hard competency consists of 10 competences, namely Lesson Plan; Introduction Activities: Apperception and Motivation; Submission of Competencies and Activity Plans; Core Activities: Mastery of Learning Materials; Application of Learning strategies; Application of the Scientific Approach; Utilization of Learning Resources / Media in Learning; Involvement of Students in Learning; Correct and Appropriate Language Mastery in Learning; and Closing.

Soft competency related to behavior competency, divide into Core Competency (CC) and Supporting Competency (SC). The core competency consists of 5 competences, namely Praying together; Watching/Teaching Al Qur’an; Using language appropriately (Arabic or English); Watching Night Learning; and Additional Activity. The supporting competency consists of 8 competences, namely Family Development; Inclusive; Integrity; Respect and Responsibility; Self-confidence; Self-control; Team work and Cooperation; and Passion for Learning.

3. Result and Discussion

3.1. Data Analysis

Hard competences are initialized by H, like shown in Table 1. Soft competences are initialized by S, like shown in Table 2.

**Table 1.** Hard Competency.

| No. | Criteria          | Competences                                      |
|-----|-------------------|--------------------------------------------------|
| 1   | H1                | Lesson Plan                                      |
| 2   | H2                | Introduction Activities: Apperception and Motivation |
| 3   | H3                | Submission of Competencies and Activity Plans     |
| 4   | H4                | Core Activities : Mastery of Learning Materials   |
| 5   | H5                | Application of learning strategies               |
| 6   | H6                | Application of the Scientific Approach           |
| 7   | H7                | Utilization of Learning Resources / Media in Learning |
| 8   | H8                | Involvement of Students in Learning               |
| 9   | H9                | Correct and Appropriate Language Mastery in Learning |
| 10  | H10               | Closing                                          |

**Table 2.** Soft Competency.

| No | Criteria          | Competences                                      |
|----|-------------------|--------------------------------------------------|
|    | Core Competences  |                                                  |
| 1  | S1                | Praying together                                 |
| 2  | S2                | Watching/Teaching Al Qur’an                      |
| 3  | S3                | Using language appropriately (Arabic or English) |
|   |   | Supporting Competences |
|---|---|------------------------|
| 4 | S4 | Watching Night Learning |
| 5 | S5 | Additional Activity |
| 6 | S6 | Family development |
| 7 | S7 | Inclusive |
| 8 | S8 | Integrity |
| 9 | S9 | Respect and Responsibility |
| 10 | S10 | Self-confidence |
| 11 | S11 | Self-control |
| 12 | S12 | Team work and Cooperation |
| 13 | S13 | Passion for Learning |

Each of these competences in table 1 and table 2 had been assessed using 5 likert scales, namely 1, 2, 3, 4, 5 ascending, like shown in Table 3. Related to Table 2 and Table 3, the average value of CC (S1 up to S5) become determining value of SC. If the average value of CC ≥ 3, then the normalization value of each SC values will be times with 25% of its value as added value. But, if the average value of CC ≤ 2, then the weight of SC values will be times with 0%.

| Table 3. Value of competences. |
|-------------------------------|
| Description | 1 | 2 | 3 | 4 | 5 |
| Never | Ever | Rare | Often | Always |

3.2. System Design

Design program application is illustrated using the UML diagram. Functional view system is described by use case diagram. The activities performed by Admin, Head of Division, Supervisor, Head of The Human Resources and Development Division, Moderation Member and Teachers. Activities performed by admin start with login into admin account, admin can manage accounts data, manage privileges data, manage assessor guru (the teacher’s assessor) data, manage the assessment of teachers data and can see the ranking result of assessment data. Activities performed by Head of Division start with login into Head of Division account. He/she can assess soft competency. Hard competency can be assessed by Supervisor after login into Supervisor account. The Soft competency then continued by Kabag PSDM (HRD manager) activities on this system after login into her/his account. HRD manager can approve the soft competency assessment. The teachers’ soft competency assessment then continued by Moderation Member to process the soft and the hard assessments. Moderation Member is consisting of the organization managements and all of supervisor department as the decision maker. Guru (the teachers) performed on this system started by login into guru account, Guru can approve the assessment and at the end of the process, Guru can see the final result of their own assessment.

3.3. System Implementation

Analysis and design stages can be applied into the program in the stages of system implementation. According to the purpose of this research to make a decision support system to help decision maker decide the best performance teacher using MOORA method quickly and more accurate.

a. Login Page

The login page is the first page when users open the login page according to their privileges account. Login page can be seen at Figure 2.

![Figure 2. Login Page.](image2)

![Figure 3. Hard Competency Page.](image3)
b. Hard Competency Page
The hard competency page displays the assessment of specific guru. The point of assessment using checkbox buttons, the supervisor can choose more than one value that were accomplished by current teacher. The process button can be pressed after all of the point assessments have been chosen. Hard competency page can be seen at Figure 3.

c. Soft Competency Page
The soft competency page displays the assessment of specific guru. The point of assessment using radio button, Head of Division can choose only one value that was accomplished by current teacher. Appropriate to hard competency page, the process button can be pressed after all of the point assessment had been chosen. Soft competency page can be seen at Figure 4.

d. Final Result of Decision Making
The final result of decision-making page shows the results of the calculation using MOORA method based on hard and soft competency. The final result arranged ascending, like showing at the Figure 5.

3.4. System Testing
Testing is done to compare the results of calculation of MOORA method with decisions taken by decision makers. Testing was doing at Islamic Boarding Daar el-Qolam 2 School and using the history data of the best performance teacher that were held from year 2015 even semester until year 2017 even semester. The used data is the data from teachers who teach subjects except Arabic. There are 10 teachers data as the alternatives who will be calculated by the system.

Below is form a decision matrix \( X \) corresponding to equation (1).

\[
X = \begin{bmatrix}
4 & 3 & 4 & 4 & 3 & 3 & 3 & 3 & 3 & 2 & 5 & 4 & 3 & 3 & 4 & 4 & 4 & 4 & 4 & 4 & 3 \\
4 & 4 & 3 & 4 & 4 & 3 & 3 & 3 & 3 & 2 & 4 & 2 & 2 & 3 & 4 & 4 & 3 & 3 & 3 & 3 & 3 \\
4 & 4 & 4 & 4 & 3 & 4 & 3 & 3 & 5 & 2 & 3 & 4 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
5 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 5 & 5 & 4 & 3 & 4 & 3 & 3 & 4 & 3 & 3 & 4 & 3 & 4 \\
4 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 5 & 2 & 4 & 2 & 3 & 4 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
5 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 5 & 2 & 2 & 2 & 3 & 4 & 3 & 3 & 3 & 3 & 3 & 4 & 3 \\
5 & 4 & 5 & 4 & 4 & 4 & 4 & 3 & 5 & 2 & 2 & 2 & 3 & 4 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
3 & 3 & 4 & 3 & 3 & 3 & 3 & 4 & 3 & 2 & 4 & 2 & 3 & 4 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
4 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 5 & 2 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
5 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 5 & 2 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\
\end{bmatrix}
\]

Furthermore, normalize the decision matrix \( X \) using equation (2). The result of normalization matrix \( X \) shows in the Table 4 and Table 5. Next is Optimizing the objective value using equation (3), value \( y_i \) obtained by add up the value of hard competences (H1-H10), and soft competences (S1-S13). Furthermore, arrange the value ascending start from the left side column, showed in Table 6.
Table 4. Normalization Value of Matrix X (Criteria H1-H10).

| Alternatives | Criteria | H1 | H2 | H3 | H4 | H5 | H6 | H7 | H8 | H9 | H10 |
|--------------|----------|----|----|----|----|----|----|----|----|----|-----|
| A1           |          | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 |
| A2           |          | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| A3           |          | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.03 |
| A4           |          | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A5           |          | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A6           |          | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A7           |          | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A8           |          | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A9           |          | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A10          |         | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |

Table 5. Normalization Value of Matrix X (Criteria S1-S13).

| Alternatives | Criteria | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 | S13 |
|--------------|----------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| A1           |          | 0.03 | 0.02 | 0.06 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 |
| A2           |          | 0.03 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A3           |          | 0.04 | 0.02 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A4           |          | 0.04 | 0.02 | 0.06 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| A5           |          | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A6           |          | 0.04 | 0.02 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A7           |          | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A8           |          | 0.03 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A9           |          | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| A10          |         | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |

Table 6. Final Value Alternatives Arranged.

| Alternatives | A4 | A5 | A6 | A9 | A10 | A7 | A3 | A1 | A2 | A8 |
|--------------|----|----|----|----|-----|----|----|----|----|----|
| Value $y_i$  | 0.53 | 0.5 | 0.5 | 0.49 | 0.49 | 0.48 | 0.47 | 0.37 | 0.35 |

Table 7 shows the comparison of decisions taken by the decision makers manually (the history/past data) with the results of decisions generated by the system. At 2015 even semester, the chosen teacher as the best performance teacher was Humaidi MZ, S.Ag. 

Table 7. Comparison of Final Decision Manually and By System.

| Assessment Period | History/past Data | Final Decision by System |
|-------------------|-------------------|--------------------------|
| 2015 Even Semester | Humaidi MZ, S.Ag. | Humaidi MZ, S.Ag.        |
| 2015 Odd Semester  | Humaidi MZ, S.Ag. | Humaidi MZ, S.Ag.        |
| 2016 Even Semester | Asep Saepulloh,M. Pd. | Asep Saepulloh,M. Pd.   |
| 2016 Odd Semester  | Asep Saepulloh,M. Pd. | Asep Saepulloh,M. Pd.   |
| 2017 Even Semester | Asep Saepulloh,M. Pd. | Asep Saepulloh,M. Pd.   |

Related to Table 7, it shows that the results of final decision taken by system using MOORA method had the same names with the history decision data.

4. Conclusion

Based on the implementation and testing, there are some conclusions that can be presented as a result of the research. This research implemented a MOORA method in web-based decision support system to decide the best performance teacher at Islamic Boarding School. It can help Islamic Boarding School to select and decide the best performance teacher quickly and objectively.

The decision support system can perform assessment using MOORA method and support the best-performing decision-making process of the best performance teachers within a defined scope. It was proved by conformity decision result between the manual decision and the system decision which have the same value with the same name of the chosen before.

References

[1] Ministry of Education and Culture Republic of Indonesia 2012
[2] Solikhun, Windarto A P and Amri 2017 Decision Support System in Predicting the Best Teacher
with Multi Attribute Decision Making Weighting Product (MADM WP) Method International Journal of Artificial Intelligence Research 1(1) 6-10

[3] Sharda R, Delen D, Turban E 2014 Business Intelligence and Analytics (10th edition) (The United States of America: Pearson Education)

[4] Fanti M P, Lacobellis G, Nolich M, Rusich A, Ukovich W 2017 A Decision Support System for Cooperative Logistics IEEE Trans. Autom. Sci. Eng. vol 14(2) pp 732-744

[5] Chanwijit J, Lomwongpaiboon W, Dowjam O, Tangworakitthaworn P 2016 Decision Support System for Targetting Higher Education IEEE-Fifth (ICT-ISPC) (Nakhon Pathom: IEEE)

[6] Kasie F M, Bright G and Walker A 2017 Decision Support System in Manufacturing: A Survey and Future Trends Journal of Modelling in Management 12(3) 432-454

[7] Ramadiani, Marissa D, Jundillah M L, Azainil, Hatta H R 2017 Simple Additive Weighting to Diagnose Rabbit Disease ICENIS vol 31 pp 1-2

[8] Jasri, Siregar D and Rahim R 2017 Decision Support System Best Employee Assessments with Technique for Order of Preference by Similarity to Ideal Solution IJTER 3(3) 6

[9] Turban E, Aronson J E, Liang T P 2005 Decision Support Systems and Intelligent Systems (New Jersey: Pearson Education Inc)

[10] Chakraborty S 2011 Applications of the MOORA Method for Decision Making in Manufacturing Environment The International Journal of Advanced Manufacturing Technology 54(9-12) 1156-1166