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Optimizing Placement of Field Experience Program: An Integration of MOORA and Rule-Based Decision Making

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ABSTRACT

The lack of optimality in the Field Experience Program (FEP) placement has affected universities' educational services to the stakeholders. Bringing together the stakeholders' needs, university capacities, and participants' willingness to quality and quantity is not easy. This study tries to optimize the placement of FEP by considering the interests of multiple perspectives through the application of Multi-Objective Optimization on the Basic of Ratio Analysis (MOORA) and Rule-Based methods in the form of a decision-making model. MOORA ranked the students based on the FEP committee's perspective and other criteria, such as micro-teaching grades, final GPAs, study programs, number of credits, and student addresses. Meanwhile, the school perspective was ordered based on its accreditations, levels, types, facilities, and performances. To achieve the optimal recommendation of FEP placement, the integration of MOORA and Rule-based intertwined the requirement of such perspectives. A prototype of the system recommendation is then acquired to simplify the decision-making model. As adjudications, a survey from twenty stakeholders evidenced around 86.92% of system user acceptances. The confusion matrix testing defines the accuracy of this method reaches 78.33%. This paper reveals that the recommendation model has been successfully increasing the effectiveness of decision making in FEP placement under the needs and expectations of the entire stakeholders.

Keywords: Decision support system, multiple perspectives, optimization, recommendation system, rule-based

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INTRODUCTION

The FEP is a program to improve students' quality, a mandatory requirement before taking the final assignment course at the Faculty of Education and Teacher Training. In this program, the students carry out teaching practices and other academic activities at junior and senior high school levels set by the FEP committee for two months. Based on interviews with FEP committees, several obstacles were found, including ineffective administrative procedures, which took a long time to access and overload student placements in one school. Besides, some complaints are considered related to the quality and imbalance of student competencies delivered by school needs. The school mileage factor also becomes an obstacle for the students in applying discipline and finance in implementing programs. This equip became a significantly affecting issue, especially for initial teachers in establishing their professional identities (Gang et al., 2020). Feelings of professional unease and discomfort during the first year of teaching regarding the teacher educators' substantial and situational selves kindly influence new pedagogies and the confident practitioner towards achieving new professional identity (Julie & Katie, 2017). The initial teachers require adequate induction support to analyze the knowledge, interpret and understand the education environment setting, mission statement, curriculum, and precise nature of work; and understand the teaching. These processes help the new teacher educator evolve their epistemic, overview knowledge of schooling, the establishment and extended of pedagogy, and provide a potential platform for evaluating what to teach, when, and how (Jones et al., 2020). The world of education continues to grow and is greatly influenced by the development. Thus, it directly affects the educational system. Teachers are responsible for operating the educational system and ensuring the sustainable achievement of schools' objectives and curriculum. To date, a strong and efficient professional competency of teachers should be redefined on the development of human life and education as field competencies, pedagogical competencies, research competencies, curriculum competencies, lifelong learning competencies, social-cultural competencies, emotional competencies, communication competencies, information and communication technologies competencies and environmental competencies (Selvi, 2010). The above competencies imply developing students' competencies towards acquiring self-confidence, learning motivation, and social skills (Chan & Yeung, 2019). This issue aims to allow academics in the field to study and assess their lessons and skills critically. Yeo et al. (2008) found that teachers' efficacy in instruction, classroom management, and student engagement influenced the teacher attributes and the teacher-student relationship. Zendarski et al. (2020) examined the teacher characteristics, thus relating to the social culture competencies that significantly contributed to the child-teacher relationship quality.

In a nutshell, this research tries to respond to the importance of the teacher's roles on the student education in schools, mostly related to the formation of professionalism of the new teachers; a high demand of policy and effective mechanism during the placement of students as prospective teachers in this FEP; and the consideration of stakeholders' perspectives at the side of students' needs, FEP committees, and schools. These three perspectives give a new contribution to a more objective assessment and decision-making by developing a Decision Support System (DSS) towards FEP placement effectiveness. Thus, it provides opportunities for the professional development of new practical teachers. DSS is an application that aids in providing management recommendations in making decisions more objective by considering various alternatives and criteria defined. Understanding the knowledge-based components in decision-making (performance, attitude, and behavior) will enhance managers' influential role and key actors in making decisions (Bonjar et al., 2019). The application of DSS in assisting management decision making, especially in education, has been widely carried out (Delen et al., 2020). The EVALOE- DSS framework for teacher professional development has been recently designed by Gràcia et al. (2020) with the intention of increasing diverse student linguistic skills. Pardiyono and Indrayani (2019) applied the DSS concept in choosing private higher education based on the marketing mix model criteria. Ardana et al. (2016) developed a DSS model to select blended learning platforms for Mathematic and Information Communication Technology (ICT) learning.

Meanwhile, Ibrahim et al. (2014) integrated the DSS framework for strategic planning in Higher Education Institutions. The above research flourished the significant and successful DSS roles in solving the management, technical, professional, social and culture problems related to decision-making in education fields. Herein, the performance of the FEP program through the practice of DSS approach is strongly optimistic.

Unfortunately, most of the raised studies deploy a single perspective in solving the complexity of DSS problems. In reality, a synthesis of broad worldviews is essentially developed rather than a single perspective to recognize complex social problems' connectedness. The development of multiple perspectives generates open, honest, effective dialogues and trust among the relevant stakeholders affected by the decision. Hsu et al. (2020) explored the multiple perspectives of experts' evaluation in generating a set of influence criteria in promoting the healthcare industry innovative technologies. Meanwhile, Petkov et al. (2007) studied how the multiple perspective representations of complex managerial problems could support the integration of Multi-Attribute Decision Making (MADM) and soft systems methodologies. El-Gayar and Fritz (2010) presented a web-based multi-perspective DSS for information security planning. Yazdani et al. (2017) had successfully developed a group decision making approach in assisting the multiple perspectives of decision makers and customers values in selecting third-party logistic providers. The result revealed that the multiple perspectives substantially rose in the efficient decision support system towards the quality and reliability of decisions. The multiple perspective approach above has successfully bridged qualitative value judgments with the quantitative data relative criteria to address inquiring organizations' needs. The analysis provided captures the relevant stakeholders' subjective preferences for dealing with conflict priority and presents the trade-offs in a decision fairly.

Moreover, group decision making let the participants boost their ability to learn and stimulate their cognitive level (Carneiro et al., 2020). Therefore, the adoption of three multiple perspectives in this research (i.e., of students, FEP committees, and schools) enhances decision-making effectiveness. More importantly, organizational learning continues towards sustainable gains in productivity and organizational excellence. Many methods have been applied in figuring out the problems related to MADM, including the simple additive weighting method (SAW) (Engel et al., 2017), the analytic hierarchy process (AHP) (Fox et al, 2015; Okfalisa et al., 2018; Leny & Okfalisa, 2019), and the technique for order preference by similarity to ideal solution (TOPSIS) (Conejero et al., 2020), ELECTRE (Mishra et al., 2020) and the latest is MOORA (Okfalisa et al., 2020). Besides, Martusorn et al. (2019) tried to compare the effectiveness of SAW, AHP, and TOPSIS in selecting a suitable warehouse location. The existing techniques have exclusively addressed their benefits and highlighted the attributes of various analyses such that their value can be clarified by using the technique-based of case completion efficiently. As comparatively, the AHP approach and its derivatives, including ANP, Fuzzy AHP, and Fuzzy ANP have intensity emphasizes resolving the bias of weight assessment and analysis sensitivity (Okfalisa et al., 2021). The reviews of MADM methods are disclosed at Table 1.

MOORA was first introduced by Brauers and Zavadskas (2006) to work out the various complex and conflicting decision-making issues for optimal decision purposes. MOORA responds to the representative alternatives concerning that particular objective by calculating the square root of each alternative's sum of squares per objective chosen (Brauers, 2008). MOORA accommodates multiple criteria in simple computational procedures. Thus, a particular single equation is required for decision matrix normalization irrespective of the nature criteria (Madić et al., 2015). This technique has been successfully showing the perfect correlation for order preference to the ideal solution. It is not affected by introducing any additional parameters (Stanujkic et al., 2012) and undefined of the criteria weights (Chakraborty, 2011). MOORA can simultaneously consider the numbers of quantitative and qualitative selection attributes (Gadakh et al., 2013).

The MOORA application in various scientific fields has been carried out, including MOORA and Goal Programming for solving credit lending decision-making problems for real-time commercial banking environment (Yusuf, 2019), AHP-MOORA for solving the composite material selection for structural component development. Herein, the ration system, multiplicative, and the reference point of MOORA used to compare and rank the proposed materials (Patnaik et al., 2020), integrated MOORA and DEMATEL-ANP to provide optimum sensitivity analysis and consistency decision-makers' priorities

Table 1
The reviews of MADM approaches

MADM Approach	Advantages	Method Extension	Reference
AHP	1. Focus on weighting of evaluation criterion. 2. Determine the significant weight and prioritize of criterion 3. Dealing with human bias during the knowledge transformation of decision makers	AHP-Entropy; AHP-OMAX; Fuzzy AHP; Fuzzy C Mean (FCM) – Fuzzy AHP; Quality Function Deployment (QFD) – Fuzzy ANP; Fuzzy AHP; ANP	Du et al. (2020); Okfalisa et al. (2018); Mangla et al. (2017); Kazemi et al. (2020); Mistarihi et al. (2020); Li et al. (2020)
SAW	1. Commonly applied for converted negative criteria into positive value. 2. Determine the weighted summation values for each alternative and assessment criteria. 3. Finding the complete ranking of the alternatives	SAW-HFL Additive Ratio Assessment (ARAS); AHP – SAW; Fuzzy SAW and Fuzzy TOPSIS; Fuzzy SAW	Büyüközkan & Güler (2020); Kumar et al. (2019); Roszkowska & Kacprzak (2016); Mukodimah et al. (2018); Engel et al. (2017)
TOPSIS	1. Can be used to determine the weights of decision makers 2. Commonly applied for ranking the alternatives and to select the best one 3. Considering both positive-ideal and negative-ideal solutions in decision-making.	Fuzzy TOPSIS; TOPSIS; TOPSIS with Hesitant Pythagorean Fuzzy Sets.	Gündoğdu & Kahraman (2019); Kacprzak (2019); Liang & Xu (2017); Memari et al. (2019); De Farias Aires & Ferreira (2019); Martusorn et al. (2019); Conejero et al. (2020).
ELECTRE	1. Can be used to calculate and rank the criteria and alternatives. 2. Famous for its outranking relations to rank a set of alternatives. 3. Applied to determine the concepts of concordance and discordance relations among alternatives. 4. Effective application in group decision-making environment	Intuitionistic Fuzzy (IF)-DEMATEL and IF-ELECTRE; ELECTRE III with weighted Borda rule; ELECTRE; ELECTRE and Pythagorean Fuzzy Sets	Kilic et al. (2020); Liao et al. (2020); Fei et al. (2019); Mishra et al. (2020); Akram et al. (2019).
MOORA	1. Overing some of the available decision-making methods include fewer mathematical computations, less computational time, more simplicity, and more stability compared with other MADM 2. Proposing optimum materials and stable ranking result. 3. One of the latest MADM methods that covers the weakness of other older methods. 4. Has been applied in many selections case study and fields of research background.	FCM – MOORA; Fuzzy MOORA; Fuzzy MOORA – FMEA; MOORA; MULTIMOORA; AHP-MOORA; MOORA and Goal Programming; MOORA and DEMATEL-ANP; MOORA-based Taguchi	Dabbagh & Yousefi (2019); Emovon et al. (in Press); Arabsheybani et al. (2018); Shihab et al. (2018); Omrani et al. (2019); Yusuf (2019); Patnaik et al. (2020); Dinçer et al. (2019); Liang et al. (2020).

for the recommendation of the financial service in E7 economy evolution (Dinçer et al., 2019), application of MOORA-based Taguchi method for predicting the optimal welding parameters by considering the multiple quality of perspectives (Liang et al., 2020), MOORA and FCM as a hybrid decision-making system for prioritizing Occupational Health and Safety (OHS) risks based on the proposed weight of FCM approach (Dabbagh & Yousefi, 2019). As a result, the previous works derived that MOORA can consider all the attributes essential and provided a better accurate evaluation of the alternatives. Arabsheybani et al. (2018) also found that MOORA accommodated the optimum decision-making methods with uncomplicated mathematical computations, low execution time, more simplicity, and revealed stable ranking result compared with others MADM techniques.

Moreover, the sensitivity analysis approach of MOORA continues to evolve and be enhanced through the integration process with various MADM approaches.

Therefore, this study applies the MOORA method in prompting the proposed alternatives by each perspective. Every perspective has measurable attributes to quantitatively well-defined the alternative solutions, viz., micro-teaching grades, final GPA, study programs, number of credits and student address, the school accreditation, the school level, the school type, the school facilities, and the school performance. The objective consists of the optimization model as well as maximization or minimization of an attribute. The satisfaction of all perspectives becomes the primary consideration that must be revealed in this research. Herein, MOORA defines the robustness in connection with multiple objectives and conditions set in this case.

Furthermore, to inextricably link the MOORA optimization ranking from both perspectives, a rule-based concept with forwarding chaining inference is applied. Rule-based is capable of selecting the minimal and representative criteria objectively and reliably for forming the MADM model and overlooking the inter-relationships among the involved criteria towards the continuous improvement and the measurement of underestimated effect of non-additive aggregators (You et al., 2019). By deploying the rule bases, the MADM method can translate decision-makers' knowledge and explanation facilities into quantitative and qualitative analytical functions. The integration of body knowledge in MADM and the expert system paradigm is represented by a MOORA and Rule-based embodiment, thus explicitly articulating the stakeholders' knowledge about a particular decision-making issue. Thus, the recommendations given are expected to meet each perspective's needs and interests by considering the defined criteria' value.

The suitable pair proposed is, without a doubt, the most incredible combination according to the parameters' significance. As a limitation, this research was conducted on the execution of the FEP at Education and Teacher Training Faculty of Universitas Islam Negeri Sultan Syarif Kasim Riau, which involved a total number of 1,036 students in the year 2018/2019 from seven study programs, including the Islamic Religious Education, Arabic Language Education, English Language Education, Economic Education, Chemical Education, Mathematics Education, and Counseling Guidance.

MATERIALS AND METHODS

Several activities were carried out this research. First, the problem identification process was put into practice qualitatively through interviews and focus group discussion with one FEP manager, two heads of departments, two deputy dean, two schools' management, and thirty-five students as participants. The FEP managers, head departments, deputy dean, and schools' management were asked due to their responsibility in handling this program. Meanwhile, the representative students from the post participants were discussed their problematics and expectation of this program. As a result, a pattern of the FEP procedure was defined. The emerging of various obstacles encountered during the execution from both perspectives. Several possible variables were also formulated and proposed as criteria, such as the students perceives criteria viz., the value of micro-teaching (C1), final GPA (C2), program study (C3), credit numbers (C4), and student address (C5). Concurrently, the school apprehends criteria expressly school accreditation (C1), school level (C2), school type (C3), school facilities-Wifi (C4), school facilities-labour (C5), school facilities-library (C6), school facilities-air conditioner (C7), and school performance-Adiwiyata (C8). The determination of criteria weight for the FEP placement was set during the discussion (details are described in the Result and Discussion section). Quantitative literature reviews have been structured to reinforce the formulation of standards. As the main activity, the optimization analysis of current program participants delegated by forty students and ten schools was preliminarily examined through MOORA.

A series of MOORA flow processes is followed, namely the formation of matrices (Equation 1), the determination of normalized matrices (Equation 2), the determination of weighted normalization matrices (Equation 3), and the determining preference values (Equation 4).

1. Matrix Formation

$$Xij = \begin{bmatrix} X11 & X12 & X1n \\ X21 & X22 & X2n \\ Xm1 & Xm2 & Xmn \end{bmatrix} \quad (1)$$

xij = the result of matrix formation
x = the value of each criterion
i = the criterion value
j = the alternative value
m = the criterion value to m
n = the alternative value to n

2. Normalize matrix determination

$$x\overline{ij} = \frac{xij}{\sqrt{\sum_{j=1}^{m} x^2{}_{ij}}} \quad (2)$$

(j = 1, 2…, n)

$x\overline{ij}$ = the average of the *i*-*th* criteria to the value of the *j*-*th* criteria

xij = the matrix formation

i = the value derived from the number of criteria

j = the value derived from the number of alternatives

n = the number of alternative values up to *n*

3. Weighted normalize matrix determination

$$yi = \sum_{j=1}^{g} Xij * \sum_{j=g+1}^{n} Wj \quad (3)$$

yi = the result of weighted matrix multiplication

wj = the weight value of the j-th criterion

xij = values of each matrix formation

4. Preference value determination

$$yi = \sum_{j=1}^{g} WjXij - \sum_{j=g+1}^{n} WjXij \quad (4)$$

yi = the result of weighted matrix multiplication

wj = the weight value of the j-th criterion

xij = values of each matrix formation

Finally, the highest rank of student and school alternatives was merged using the rule-based to track the appropriate recommendation pair. A decision tree diagram is then developed based on the association rules defined by the stakeholders. To automate the integration of MOORA and rule-based calculation, a prototype DSS was constructed. Object-Oriented and Unified Modeling Language (UML) tools were applied in system analysis and design. These tools have demonstrated a promising future as a pragmatic methodology in modelling DSS, including user interface, architectural design, analysis and design, programming, data management, and model management (Liu & Stewart, 2004). The visualization derives from this powerful approach is capable in interactively express the immersive learning of information and knowledge of the respondent, as examples Kumar et al. (2019) designed web-based object-oriented decision support system for coastal water quality prediction and Sztubcka et al. (2020) deployed Geographic Information Systems as innovative DSS in identifying the potential location for energy efficiency improvement. Thus, the adoption of the object-oriented technique has been successfully generated the dynamic analytical and development of multi-attribute decision making components of DSS. Furthermore, Blackbox Testing, User Acceptance Testing (UAT), and Confusion Matrix were systematically organized in testing the work out functionality, the user responses, and the accuracy comparison for 120 test data simulation. Blackbox testing and UAT are commonly and effectively applied for software development testing (Pressman & Maxim, 2020).

Below is the description of the Confusion Matrix. It is acceptable and straightforward for classification algorithms and area estimation models (Lewis & Brown, 2001; Han at al., 2011) (Equation 5 & 6).

$$\text{Accuracy} = \frac{TP+TN}{P+N}\ x\ 100\% \tag{5}$$

$$\text{Error-rate} = \frac{FP+FN}{P+N}\ x\ 100\% \tag{6}$$

TP (True Positive) = The amount of correctly classified data (*Actual class (yes), Predicted class (yes)).*
TN (True Negative) = The amount of correctly classified data (*Actual class (no)*, *Predicted class (no)).*
FN (False Negatif) = The amount of incorrectly classified data (*Actual class (yes), Predicted class (no)).*
FP (False Positif) = The amount of incorrectly classified data (*Actual class (no), Predicted class (yes)).*
P = Total of *TP* and *FN*
N = Total of *FP* and *TN*

Blackbox Testing is a structural software evaluation technique used to analyze system functionality, requirement analysis validation, system integration relates to the codification review, acknowledging the customer's requirement analysis phase, and the system regression test (Nidhra, 2012; Copeland, 2004). Meanwhile, UAT is conducted by disseminating the questionnaire with five Linkert scales to measure the respondents' agreement related to the system utilization, procedures, and the recommendations offered by this prototype DSS system (Davis & Venkatesh, 2004). UAT is essential in grabbing information and profound knowledge relevant to the validation and acceptance of the solution.

RESULTS AND DISCUSSIONS

Problem Identification

Based on the observations and interviews, the flow of FEP student placement activities is described in Figure 1. The current system was manually performed and randomly positioned without considering any particular criteria. Students enrolled for the FEP program at the front desk of committee services. Next, the committee checked the validity of documents' requirements by referencing the faculty data, including students' status, micro-teaching score, final GPA, study programs, and credits. The committee applied word and excel programming to make the recapitulation and data classification. Finally, the committee randomly placed the students for the FEP program. The FEP placement report will be announced and conducted based on the proposed date and schools. As a result, manually operated of registration, data validation, and data recapitulation triggered the un-effective time management on the side of committee services. Lack of students' discipline during the registration process caused the target's achievement not to set as expected. The committee services were disappointed on the schools' side, especially regarding time management, students' quality and competencies, students' discipline, students' requirements, and quota allocation. By referring to Indonesia's government regulation No. 13 the Year 2015 about national education standard, Indonesia Ministry of Environment No. 05 the Year 2013, and focus group discussion summary during the interview session, student performance can be assessed through the score value of micro-teaching, final GPA, program study, numbers of credits, and students' location. Microteaching provides a space for the pre-service teacher to evaluate their teaching (Saban & Coklar, 2013) by considering the timing, planning, asking questions, management of the class, materials usage, and physical appearance in front of the class. The value of micro-teaching practices contributes to the pre-service teachers' qualifications and experiences. Hemdi et al. (2016) found that the cumulative GPA recognized as the holistic student academic assessment mechanism clearly described their actual ability, knowledge, skills, and attitude. Understanding GPA is beneficial for the students, faculty, university, and external stakeholders in identifying the students' strengths

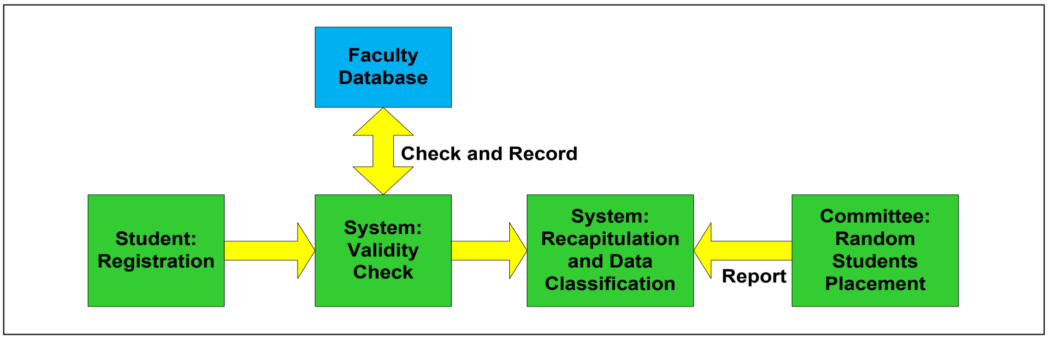

Figure 1. Flow diagram for FEP student placement

and weaknesses for vacancy allocation. Concurrently, the school appraisal encompasses the school accreditation, the school level, the school type, the school facilities, and the school performance. School accreditation evaluates the school's quantitative educational quality judgment of facilities, resources, and teaching. The accreditation mirrors the broad aspects of teacher competencies and values during the educational program (Davis & Ringsted, 2006). Cherchye et al. (2010) exhibited that environmental characteristics in terms of the school type private and public sector positively impact the educational output in efficiency and equity. The Indonesian government introduced the Adiwijaya program to encourage knowledge creation and school awareness of nature (Krisnawati et al., 2015). The program embodies the environmental policy, environmental-based curriculum, participative activities, and environmental facilities management. In a nutshell, the school performance is valuably measured through Adiwijaya program availability.

Criteria Formulation

The formulation of criteria is defined in Tables 2 and 3. The weights of its priority are put in place following the summing up of focus group discussion. The discussion revealed the weighted of students' criteria as in Table 2, thus C1-The Value of Micro-teaching set as the most priority criteria at 30% weighted value following by C2-Final GPA, C3-Program Study, C4- Credit Numbers, and C5- Student Address, respectively. The values of Max and Min for each criterion is referred by MOORA regulation for optimum and minimum values. The value of micro-teaching subsumes in grade A, A-, B+, B, B-, C+, and C with weight precedence into score 4.00, 3.70, 3.30, 3.00, 2.70, 2.30, and 2.00, respectively. The final GPA is specified as more than equal to 2.75. Program study is covered into seven programs, viz., Chemistry Education (P1), Economic Education (P2), English Language Education (P3), Mathematics Education (P4), Counseling Education (P5), Islamic Religious Education (P6), and Arabic Language Education (P7) with the weight emphasis from seven to one accordingly. Credit numbers are designated not less than 120 credits. Criteria for student address encompasses the distance from school 0 to 500 meter, 500 to 2000 meter, and more than 2000 meter. The weights are generated into the value of three, two, and one, respectively.

Table 3 explained the weight of school criteria whereby C1-School Accreditation is denoted as the weightiest priority criteria at 30%. It is then pursued by C2-School Level, C3-School Type, C4-School Facilities (Wifi), C5-School Facilities (labour), C6-School Facilities (Library), C7-School Facilities (Air Conditioner), and C8-School Performance (Adiwiyata), respectively. The school's accreditation (C1) is measured in grades A and B thus, the weights in each case are specified in subject values of four and three. The school-level (C2) criteria contain the sub level in senior high school (TS1), Islamic senior high school (TS2), vocational high school (TS3), junior high school (TS4), an Islamic junior

Table 2
Weight of student criteria

No.	Criteria	Weight	Value
C1	The Value of Micro-teaching	30%	Max
C2	Final GPA	25%	Max
C3	Program Study	20%	Max
C4	Credit Numbers	15%	Max
C5	Student Address	10%	Min

Table 3
Weight of school criteria

No.	Criteria	Weight	Value
C1	School Accreditation	30%	Max
C2	School Level	25%	Max
C3	School Type	15%	Max
C4	School Facilities (Wifi)	5%	Max
C5	School Facilities (labor)	5%	Max
C6	School Facilities (Library)	5%	Max
C7	School Facilities (Air Conditioner)	5%	Min
C8	School Performance (Adiwiyata)	10%	Min

high school (TS5) with the circumscribed weight from five to one, respectively. The school type (C3) is explained in public and private schools by considering the weighted priority in two public and private schools. Concurrently, the school facilities (C4-C7) and performance (C8) are determined by their availability, one weighted for provided, and zero for the rest.

MOORA Analysis

Following Equation 1, Tables 4 for forty (A1 to A40) students' matrix formation against the values of each criterion (C1 to C5) are elucidated. Subsequently, Equation 2 calculation for students' normalization matrix is spelt out as in Table 5. Table 6 is then declared according to the MOORA estimation in Equation 3 to denote the students' weighted matrix's normalization across criteria. Besides, Table 7 indicates the value of student's preference conforming to the Equation 4. Thus, it ranks the students from the highest score of *Yi* at student-A6 (0.1468), student-A25 (0.1466), student-A27(0.1462), student-A28 (0.1461), student-A20 (0.1455), and student-A22 (0.1452). Furthermore, a similar calculation from Equation 1 to 4 is applied to the side of the school perspective. As a final result, Table 8 shows the schools' place appertaining to the values of *Yi* where school-A4 as the highest score at 0.2713, following by school-A3 (0.2610), school-A2 (0.2474), school-A1 (0.2372), school-A8 (0.2067), school-A6 (0.1998), school-A10 (0.1986), school-A5 (0.1833), school-A7 (0.1759), and school-A9 (0.1728) accordingly.

Table 4
Student matrix formation

A	C_1	C_2	C_3	C_4	C_5
A_1	3.3	3.50	5	136	3
A_2	3.3	3.17	5	132	1
A_3	2.7	3.36	5	136	2
A_4	3.3	3.37	5	136	3
A_5	4	3.30	5	136	2
....	....	....	....	....	....
A_{36}	3	3.18	3	132	1
A_{37}	3.3	3.55	3	132	3
A_{38}	2.7	3.73	3	134	1
A_{39}	4	3.49	3	132	2
A_{39}	4	3.49	3	132	2
A_{40}	2	3.26	3	134	3
$\sum C_n$	20.2776	21.4116	28.5482	833.9017	13.8203

Table 5
Student normalization matrix

A	C_1	C_2	C_3	C_4	C_5
A_1	0.1627	0.1635	0.1751	0.1631	0.2171
A_2	0.1627	0.1481	0.1751	0.1583	0.0724
A_3	0.1332	0.1569	0.1751	0.1631	0.1447
A_4	0.1627	0.1574	0.1751	0.1631	0.2171
A_5	0.1973	0.1541	0.1751	0.1631	0.1447
....	....	....	....	....	....
A_{36}	0.1479	0.1485	0.1051	0.1583	0.0724
A_{37}	0.1627	0.1658	0.1051	0.1583	0.2171
A_{38}	0.1332	0.1742	0.1051	0.1607	0.0724
A_{39}	0.1973	0.1630	0.1051	0.1583	0.1447
A_{40}	0.0986	0.1523	0.1051	0.1607	0.2171

Table 6
Students normalization weighted matrix

A	C_1	C_2	C_3	C_4	C_5
A_1	0.0488	0.0409	0.0350	0.0245	0.0217
A_2	0.0488	0.0370	0.0350	0.0237	0.0072
A_3	0.0399	0.0392	0.0350	0.0245	0.0145
A_4	0.0488	0.0393	0.0350	0.0245	0.0217
A_5	0.0592	0.0385	0.0350	0.0245	0.0145
....	....	....	....	....	....
A_{36}	0.0592	0.0333	0.0280	0.0212	0.0145
A_{37}	0.0444	0.0371	0.0210	0.0237	0.0072
A_{38}	0.0488	0.0414	0.0210	0.0237	0.0217
A_{39}	0.0399	0.0436	0.0210	0.0241	0.0072
A_{40}	0.0592	0.0407	0.0210	0.0237	0.0145

Table 7
Student preference value

A	Max(C_1+C_2+C_3+C_4)	Min(C_5)	Yi = Max - Min
A_1	0.1492	0.0217	0.1275
A_2	0.1446	0.0072	0.1374
A_3	0.1387	0.0145	0.1242
A_4	0.1477	0.0217	0.1260
A_5	0.1572	0.0145	0.1427
A_6	0.1540	0.0072	0.1468
....	....	....	....
A_{36}	0.1263	0.0072	0.1190
A_{37}	0.1350	0.0217	0.1133
A_{38}	0.1286	0.0072	0.1214
A_{39}	0.1447	0.0145	0.1302
A_{40}	0.1128	0.0217	0.0911

Table 8
School preference value

A	Yi	C_1	C_2	C_3	C_4	….	C_8
A_4	0.2713	4	5	2	1	….	1
A_3	0.2610	4	5	1	0	….	0
A_2	0.2474	4	4	2	1	….	1
A_1	0.2372	4	4	1	0	….	0
A_8	0.2067	3	3	1	0	….	0
A_6	0.1998	4	2	2	1	….	1
A_{10}	0.1986	4	3	2	0	….	1
A_5	0.1833	4	1	1	0	….	0
A_7	0.1759	4	1	2	1	….	1
A_9	0.1728	4	2	1	0	….	0

Rule-based Application

Rule-based construction was carried out by considering the variables of the study program (C3) from the students' perspective and school level (C2) from the school's perspective. Decision Tree Diagram can be depicted in Figure 2.

Rule-based development is presented as follows:

Rule 1: IF [P1] OR [P2] THEN [TS1, TS2]

Rule 2: IF [P6] OR [P7] THEN [TS2, TS5]

Rule 3: IF [P3] OR [P4] OR [P5] then [TS1, TS2, TS3, TS4, TS5].

In a nutshell, the selected students at the side of committee perspectives are merged with the preferred schools from the school perspective. Thus, it is pursuing the rule-based

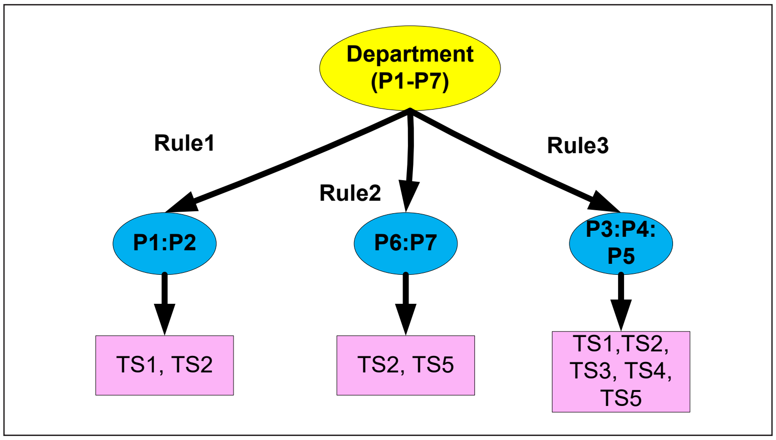

Figure 2. Decision tree diagram for FEP rule-based

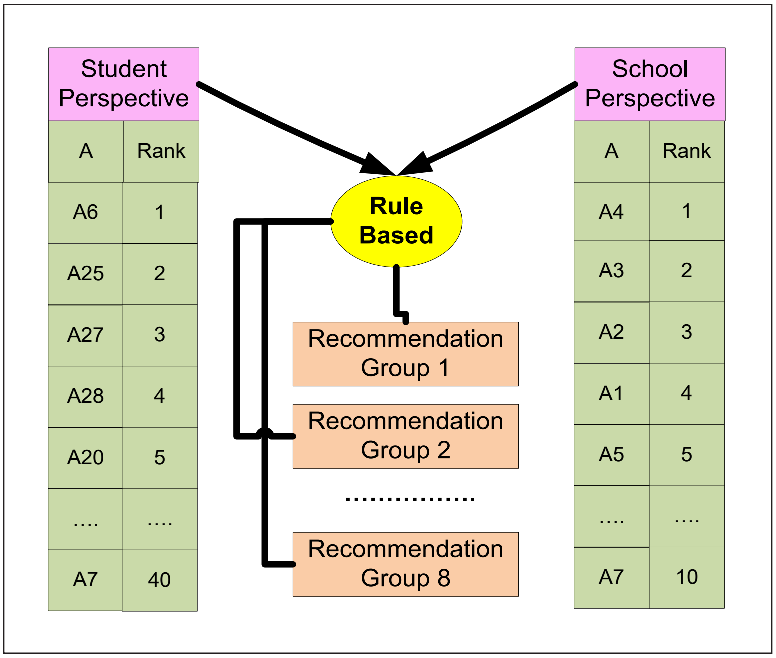

Figure 3. Integration of MOORA and Rule-based

formula as above (Rule 1 to 3). As a result, eight groups recommendation as in Table 9 is then suggested in Figure 3. Figure 3 elucidated that group one's recommendation is revealed from the first five rank students (A6, A25, A27, A28, A20) to be placed in the first three order schools (A4, A3, A2). The recommendation group two puts the sixth position students (A22, A24, A26, A5, A2) into school-A3, school-A2, school-A1, and reciprocally. For the detailed integration of MOORA and rule-based in eight groups, the detailed recommendation is interpreted in Table 9.

Table 9
FEP student placement recommendation

Recommendation Group 1					
Alternatives (Student) by Rank		Department	Alternatives (School) by Rank		School Level
A_6	1	P3	A_4	1	TS1
A_{25}	2	P1	A_3	2	TS1
A_{27}	3	P1	A_2	3	TS2
A_{28}	4	P1			
A_{20}	5	P2			
Recommendation Group 2					
A_{22}	6	P2	A_3	2	TS1
A_{24}	7	P2	A_2	3	TS2
A_{26}	8	P1	A_1	4	TS2
A_5	9	P7			
A_2	10	P7			
Recommendation Group 3					
A_{30}	11	P1	A_2	3	TS2
A_{21}	12	P2	A_1	4	TS2
A_{32}	13	P4	A_5	5	TS3
A_{14}	14	P6			
A_{39}	15	P5			
...	...	...	...	...	...
Recommendation Group 8					
A_{11}	36	P7	A_9	8	TS5
A_{10}	37	P7	A_{10}	9	TS5
A_{40}	38	P5	A_7	10	TS4
A_{13}	39	P6			
A_7	40	P7			

This study has generally established how the simple mathematical calculation in MOORA reveals the best decision-making by taking potential attributes into account (Arabsheybani et al., 2018) and prioritizing the alternative from several perspectives, namely students and schools' sides. This result is reinforced by Patnaik et al. (2020) findings that used the MOORA to juxtapose the material alternatives and correctly order them. Further, this study's evidence stated how a rule's functionality based on the IF-THEN feature's logical use provided the optimum recommendations from entangled rank alternatives of two sides perceives. In that sense, the rule base exhibited the ability in dealing with the complexity of possible cases and uncertainty in students placement intentions. Indeed, the algorithm of the decision tree, therefore, ensures the transparency of the student placement.

System Development

A prototype of MOORA-Rulebased-DSS system as a management information system is designed and developed to automate the procedure of FEP, starting from the registration, management data of students and schools, management data of criteria and alternatives provided, management stakeholders internal and external as users, and integrated MOORA and Rule-based calculation procedures. The MOORA-Rulebased-DSS system architecture can be seen in Figure 4. Two key figures, namely the FEP committee and administrator, have engaged in this application to date. The administrator has access to the whole process of knowledge based. In the meantime, the committee received the recommendations suggested by the application.

Testing

To evaluate the MOORA-Rulebased-DSS, a UAT assessment's survey of twenty respondents came from five of the committees, eight study program leaders, two management schools, and five management faculty. The respondents are asked their perceives on the acceptance of MOORA-Rulebased-DSS application by considering the interactive design of system

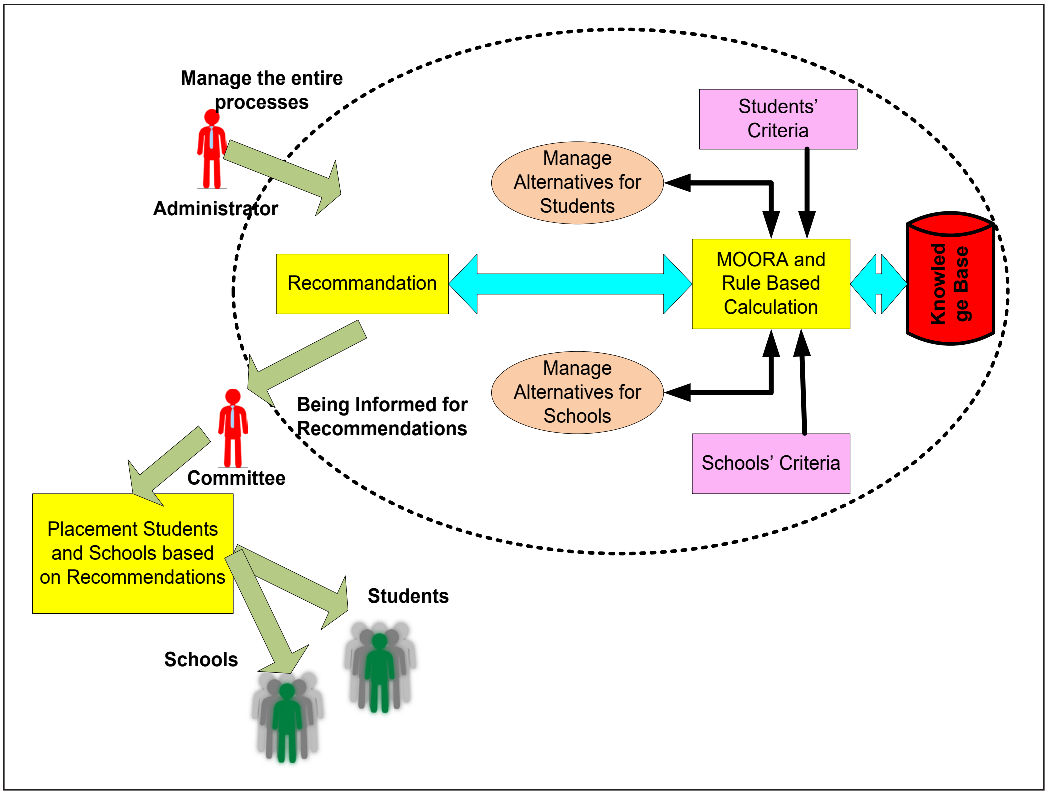

*Figure 4***.** System architecture of MOORA-Rulebased-DSS

interface (5 questions), the easy use of DSS system (5 questions), the system utilization in aiding management decision making (5 questions), and the agreement on the proposed DSS system recommendation (5 questions). As a result, it obtained a very agreeable response of 86.92% covenant. Subsequently, Blackbox testing is conveyed into several DSS system functions, including login, user updated data, students updated data alternatives, schools updated data alternative, MOORA execution, Rule-based execution, and MOORA-Rulebased execution process. The testing revealed that 100% functionality and codifying test following the requirements analysis phase and user expectations. A Confusion Matrix is then generated by referring to Equation 5 and 6. As a result, the Confusion Matrix achieved an accuracy value of 78.33% from 94 data tests with status "True" and 21.67% error rate from 26 data sets with conditional status "False". The calculation shows that this recommendation system succeeded in providing the most optimal advice in students' placement in the FEP.

CONCLUSION

This research has prevailed in propounding the optimal students' placement in the FEP. The multiple perspectives based on committee and schools have been accommodated by considering criteria and the adherence of MOORA calculation and rule based. The inclusion of rule-based has been successfully intensified the role of MOORA in optimizing the decisions. This recommendation system puts forward eight group suggestions as alternatives in placing the students for the FEP. The evaluation reveals the stakeholders' satisfaction and acceptance of the procedures and alternatives proposed. Hence, the emerging obstacles during the FEP can be minimized, and the stakeholders' amusement will be increased. Besides, the advancement of traineeship procedure and the suggested solution's objectivity impact the committee's performance towards the optimal, effective, and efficient services, especially in decision-making. Due to the constraints of user capabilities and knowledge from the committee, students, and schools' side on DSS system operation, the administration's role is playing significant values in managing the knowledge-based and data modelling. Therefore, future studies are encouraged to design the dynamic and smart DSS system. Therefore, all stakeholders will be directly involved and manage the knowledge based on the criteria and alternatives provided. Consequently, the efficiency of rule-based in complex environment tracking will linearly increase and powerful. Besides, the smart DSS system can accommodate more valuable perspectives.

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