Decision Support System Model of Teacher Recruitment Using Algorithm C4.5 and Fuzzy Tahani

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Abstract. During the new academic years, schools accept new students either at the level of elementary school (SD), junior high school (SMP), senior or vocational high school (SMA/SMK), as well as the existence of Islamic Education Teachers. Data taken from Local Office of Education (Diknas) of Magelang collaborated with Local Office of Religious Affairs (Kankemenag) of Magelang in 2015-2017, the Islamic Education Teachers (GPAI) recorded in 2015-2017 still less of 275 people of GPAI. It was caused by retirement, prolonged ill, and passed away. Diknas and Kemenag collaboration in opening the recruitment of GPAI is currently still using the manual system (Microsoft Excel), so it causes the administration data in that recruitment less objective and unaccountable, these are the obstacles in the teacher candidates’ recruitment which must be solved soon. How to make a system solves this problem. Meanwhile, the interest of Islamic Education Teacher (GPAI) candidates is high. To support and overcome this issue, an admission system of Islamic Education Teacher (GPAI) candidates is made so the results are accountable. Decision support system of teacher recruitment using algorithm C4.5 and Fuzzy Tahani is a system which can overcome this problem. Researchers try to build a system with the combination between the methods of Algorithm C4.5 and Fuzzy Tahani that can help the decision making in the recruitment of Islamic Education Teacher candidates. From the training results of 484 recorded criteria using attributes (1) Last Diploma; (2) University Accreditation; (3) The Faculty of Education; (4) Islamic Education (PAI) Department; (5) Police Certificate (SKCK); (6) Passport Photo; (7) ID Card; resulting in 290 recorded data of the Entropy and Gain calculation with an average time 3 minutes 15 seconds shows that percentage value of the final result those who cannot be recommended are 33%, then those who receive recommendation are 68%, with the value of entropy produced is 0.591672779.

1. Introduction

In 2015-2017 Magelang is still lack of Islamic Education Teachers (GPAI) which is one of the important subjects in school. Data written in Local Office of Education and Culture of Magelang (Diknas) in 2015-2017, 275 people of GPAI are still needed. Many teachers who are retired, prolonged ill and passed away. Then Education Department and Local Office of Religious Affairs (Kankemenag) collaborate to open the recruitment of GPAI candidates in Magelang. The interest of registrants to be accepted as Islamic Education Teachers from various colleges and also from various areas is very high. The Education Department and Kankemenag collaboration to open the GPAI recruitment is currently still using manual system (Microsoft Excel), so it causes the administration data in this recruitment are
less objective and unaccountable, that is the obstacle in the recruitment of teacher candidates which must be solved soon.

From the results of research and interview with the Head of Local Office of Religious Affairs and the Head of Local Office of Education of Magelang, refer to the Technical Guidance Rules on procedures of Islamic Education Teacher recruitment: Diploma of S1/D IV, Minimum Accreditation B, Faculty and Department of Tarbiyah (Education) and Islamic Education (PAI), Good Behavior (Police Certificate), Male/Female, ID Card, Photo, and others. So, not all of the candidates of Islamic Education Teachers are accepted directly, only those who fulfill the criteria and pass the selection and test will be accepted in accordance with the needs of Islamic Education Teacher candidate.

To support the smooth process of Islamic Education Teacher recruitment, a decision support system needs to be built in the Local Office of Religious Affairs Magelang. A decision support system has ever been built by Tri Murti, Leon Andretti Abdillah, Muhammad Sobri in 2015 with the title “Decision Support System of Giving Lending Feasibility Using Fuzzy Tsukamoto Method”; Maryaningsih, Siswanto, Mesterjon, 2015, “Fuzzy Tsukamoto Logic Method in the Decision System of Scholarship Grantee; Purna Iruwan, Zanial Mazalisa, Febriyanti Panjaitan 2015, “The Application of Fuzzy Tsukamoto Method in Decision Support System of Best Employees”; Ardiles Sinaga, M.T, Yessy Resti Melati, 2015, “Decision Support System of Employees Management Using Fuzzy Logic Web-based Method in PT. Premier Equity Futures, Bandung”, system with combination between the method of algorithm C4.5 and Fuzzy Tahani which later is expected to be more perfect in helping the decision making with the title used in this study “Decision Support System Model of Teacher Recruitment Using Algorithm C4.5 and Fuzzy Tahani.”

2. Research Method

2.1 Decision Support System

Decision Support System (DSS) is a system intended to support managerial decision makers in semi-structured and structured decision situations (Turban, 2005: 41). DSS can provides various benefits and advantages. The benefits that can be earned from DSS according to Kadarsah in Utami (Utami, 2012):

1. Decision Support System expands the decision makers’ ability in processing data/information for the users.
2. Decision Support System helps decision makers to solve various problems, especially those very complex and unstructured problems.
3. Decision Support System can generate solutions more quickly and the results are reliable.
4. Although a Decision Support System, may not be able to solve problems faced by the decision makers, but the Decision Support System can become a stimulant for decision makers in comprehending the problems occur because it is able to present various alternative solutions.
Figure 1. Flow of decision making system

Figure 1. is an example of how the flow of decision making process through the schema form of Decision Support System. The main components (subsystems) include data management, model management, user interface, and knowledge-based management subsystem (Turban, et al, 2005).

2.2 Data Mining

Data mining is an analysis of data sets review to find unexpected relationships and to summarize the data in a different way than before, which can be understood and useful for the data owners. Data mining is a technology used in different disciplines to find significant relationships among variables in a large data set. Data mining method can be used to classify data can be used to classify data by converting the data into a decision tree and rules, which can be utilized to predict or clarify an event.

There are two characteristics of training methods in data mining. Broadly speaking, the training methods used in data mining techniques are divided into two approaches, namely:

1. Unsupervised learning, this method is applied without training and teacher. The teacher here is label of data.
2. Supervised learning is a learning method with training and trainer available. In this approach, to find the decision function, separator function, or regression function uses several data examples that have outputs or labels during the training process.

Based on tasks that can be done, some techniques of data mining are: description, estimation, prediction, classification, clustering, and association. Some methods that can be used based on the data mining grouping. Data mining as a series of processes can be divided into several stages that have interactive characteristic, users are directly involved or through the mediation of knowledge base.
2.3 Algorithm C4.5 Method
Algorithm C4.5 is an algorithm which classifies data by decision tree technique and has many advantages (*). For example, it can process the numeric data (continuous) and discrete, can handle the missing of attribute values, resulting rules that are easy to be interpreted and fastest among other algorithms (Lutfi, *2009).

In general, the flow of Algorithm C4.5 in constructing the decision tree in data mining is as follows (Lutfi, 2009):

1. Choose attribute as the knot roots.
2. Create branch for each value.
3. Divide the case in branch.
4. Repeat the process for each branch to all of cases on the branch has the same class.

2.4 Fuzzy Tahani Method
Fuzzy tahani has 4 stages (Galindo, 2006):

1. Membership Fuction
2. Fuzzyfication
3. Query Fuzzyfication
4. Operation of fuzzy

Fuzzyfication is a conversion of firm values into fuzzy values by means of a magnitude analog as input (crisp input), then the input is entered on the scope of limitation or the domain of membership function, which is called as membership function which input and output is the fuzzy input values or so called as fuzzy input (*) (Galindo, et al,*2006). Query Fuzzyfication is assumed as a query that will try to make and apply a basic system of query fuzzy logic. The concept of a fuzzy relation in a Database Management System using membership degree µ that is defined on the domain group X = (X1,...,Xn), and have been generated in out relation by the middle values of fuzzy. Syntax query used is “Select from where”(*) (Galindo, et al,* 2006). There are 3 basic operations in fuzzy set, namely AND, OR, and NOT.

2.5 Research Data
Research data used in this study is the recruitment data of Islamic Education Teacher in Magelang year of 2012 to 2017. That data were then converted into a table of Islamic Education Teacher recruitment. These data are divided into 2 groups those are the registrant data of Islamic Education Teacher and the data of Islamic Education Teacher recruitment.

2.6 Requirement Analysis
2.6.1 Functional. Functional requirements are function that must be fulfilled on the designed application. Functional requirements which must be fulfilled by designed application are as follows:
1. System should be able to receive the input of registration data from PAI teachers in Kankemenag.
2. System can recommend the registrants to be accepted as Islamic Education Teacher (PAI) based on the method of Algorithm C4.5 and Fuzzy Tahani.
3. System can show the results of the PAI teacher recruitment based on Algorithm C4.5 and Fuzzy Tahani method.

2.6.2 Non-Functional. Analysis of non-functional requirement is an analysis required to determine the specification of requirement system, hardware and software

3. Result and Analysis

3.1 RAD Design Workshop (modeling)

3.1.1 DSS Concept. DSS concept in this study is divided into 4 working environments.
1. Data Base Management System DBMS working environment is a working environment used to keep the table contains registrant data, assessment process and the results of the selection of PAI teacher recruitment in Kankemenag.
2. Basic Knowledge contains rules of PAI teacher recruitment in Kankemenag.
3. Machine this environment contains a system that uses Algorithm C4.5 and Fuzzy Tahani to produce the recommendation of accepted PAI teachers.
4. Interface contains the display or form of the registrant data and results of recommendations.

3.1.2 System Design. System design used in this study is Unified Modelling Language. The major design in this system uses usecase diagram such as the example in figure 1 below:

![Figure 1. Usecase diagram of PAI teacher recruitment](image)

3.1.3 Menu Design. Menu design used in this study is Unified Modelling Language. Menu design in this system uses decision making system such as an example in the following Figure 2:

![Figure 2. DSS Usecase diagram of PAI teacher recruitment](image)
3.1.4 Result and Discussion. Criteria Determination. In order to make assessment, assessment criteria used are as follows. (1) Last Diploma, (2) University Accreditation, (3) Faculty of Education, (4) Islamic Education Department (PAI), (5) SKCK, (6) Photo, (7) ID Card

Phases of Criteria Consideration

1. Considering the criteria of last diploma
   Diploma criteria is divided into 6 sub criteria, those are (1) Diploma which is not graduated from senior high school (SMA), (2) Senior high school (SMA) diploma up to still having college in D3, (3) D3 diploma up to still having college in S1, (4) S1 diploma up to still having college in S2, (5) S2 diploma and still having college in S3, and (6) S3 diploma or more.

2. Considering the University Accreditation Criteria
   University accreditation where the candidates of Islamic Education (PAI) teacher is divided into 4 sub-criteria, those are: (1) Not accredited, (2) Accredited C, (3) Accredited B, (4) Accredited A.

3. Considering the Faculty of Education Criteria
   The faculty which is taken by PAI teacher candidates is divided into 2, namely: (1) Not Faculty of Education, and (2) Faculty of Education.

4. Considering the criteria of PAI Department
   The department is divided into 2, those are: (1) Not Department of Islamic Education and (2) Department of Islamic Education.

5. Considering the criteria of SKCK
   SKCK criteria are divided into 2, namely: (1) Bad behavior, and (2) Good behavior.

6. Considering the criteria of Photo
   The criteria of photo is divided into 2, those are (1) Photo that is in accordance with the ID card, (2) Photo that is not in accordance with the ID Card.
7. Considering the criteria of ID card
   ID card criteria are divided into 2, those are: (1) Instead of Magelang City ID card, and (2) Magelang City ID Card.

3.2 Result, Result of Calculation
The calculation is done by entering the value of each candidate as an Islamic Education Teacher. Then, input the value of each criterion in a table by using basic table as follows:

1. The following number is the example of cases happened under 14.
2. The table above is information about the criteria of Islamic Education Teacher candidate transformed by using the phases of criteria consideration that has been determined before, the data is taken based on the example of 14 cases which has been passed the beginning calculation by Entropy and Gain Ratio Calculation.
3. The table above is criteria information of Islamic Education Teacher candidate transformed by using the phases of criteria consideration that has been determined before, the data is taken based on the example of 14 cases which have been passed the beginning calculation by Entropy and Gain Ratio calculation.

In the calculation above, the information of the largest ratio is K1 that is diploma, so as the first filter from the registrant is by using a diploma. Then the filter will adjust the information of the second largest ratio, and so on. From this result of calculation called as recommendation, meanwhile the final decision is not on the system but in the team of advisability test. From the example of cases calculation of 484 registrants of Islamic Education teacher candidates after filtered sequentially the value of gain information obtained 290 registrants who can be recommended. This final result can be seen in the following table in the form of Pie Diagram as follows:

![Results](image)

**Figure 4.** The final result of GPAI candidate calculation

Results of the diagram above, show that percentage value of the final result that cannot be recommended is 33%, then that can be recommended is 68%, with the entropy value resulted is 0.591672779.
4. Conclusion

Based on the testing and discussion of the test result toward the decision support system of the Islamic education teacher candidate recruitment by using algorithm C4.5 and Fuzzy Tahani, the recruitment happened during 2012 up to 2017, with the criteria of using attribute (1) Last diploma; (2) University accreditation; (3) Faculty of Education; (4) PAI Department; (5) SKCK; (6) Photo; (7) ID Card, from 484 number of registrants’ data that can be recommended by Entropy and Gain calculation with the average time of 3 minutes 15 seconds shows that the percentage of the final results which cannot be recommended is 33%, then which get recommendation is 68%, with the entropy value resulted of 0.591672779, results the prediction of accuracy level average is 94.64%.

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