Recommendation System for Giving Scholarships to New Students Using TOPSIS Method

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Abstract—**Yayasan Pondok Pesantren Wahid Hasyim (YPPWH) is one of the bases of modern Islamic education in Daerah Istimewa Yogyakarta (Special Region of Yogyakarta). As one of devotion to education and society, formal education institutions, namely Madrasah Ibtidaiyah (Religion Elementary School), Madrasah Tsanawiyah (Religion Junior High School) and Madrasah Aliyah (Religion Senior High School) Wahid Hasyim currently have scholarship opportunities for students who excel and underprivileged, especially those from the local population. With the increasing number of scholarship applicants, making a challenge for the manager of the agency to be able to give a correct decision, effective and efficient in data management Fellow truly eligible to receive a scholarship. This study uses a Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The criteria used in these systems vary according to the scholarships provided by the Foundation. Based on the results of case selection calculations show that the results using the same system with manual calculations. The system is able to provide scholarships recommendation. This system has been passed fit for use for 100% testing of system functionality using the alpha test, the test results and accessing interface produces 65.15% of the respondents strongly agreed with the system interface, as well as the results of the test content for the page admin, counseling teachers and students each yield 88.89%, 83.33% and 100% of respondents stated strongly agree with making this system.**

Keyword--recommendation system; scholarship; Yayasan Pondok Pesantren Wahid Hasyim; TOPSIS.

I. INTRODUCTION

Yayasan Pondok Pesantren Wahid Hasyim (YPPWH) is one of the modern Islamic educational institutions that was established in 1966. Along with its current development YPPWH has managed 14 institutions engaged in education both formal and non-formal. As for institutions formal education consists of Madrasah Ibtidaiah (MI), Madrasah Tsanawiyah (MTs) and Madrasah Aliyah (MA), for non-formal educational institutions consisting of Madrasah Diniyah (MADIN) and Ma'had 'Aliy, then the rest are institutions engaged in developing the potential of *santri* (a student of Islamic school), such as LPM, eL-Sip, LSP, PSPB, Scholarship Institutions and Waqf Institutions.

Recognizing that YPPWH has now become a barometer of education based on boarding schools in DI Yogyakarta, then as a form of service towards the world of education and society, formal education institutions namely MI, MTs and MA Wahid Hasyim have now opened scholarship opportunities for santri those who are achievers and disadvantaged especially those from local residents. With the increasing number of applicants for scholarships, it has become a challenge for them the institution management to be able to provide an appropriate, effective and efficient decision in managing student recipient data that is truly entitled to receive a scholarship.

Currently YPPWH still uses manual methods to determine new students who are entitled to receive scholarships. So that data processing is less effective, requires a relatively long time and subjectivity often occurs from decision makers. To facilitate the management of Wahid Hasyim Scholarship Institution (LBWH) in determining new students who are entitled to receive scholarship, the Foundation administrators want to establish a recommendation system that serves to help select candidates for scholarship recipients. This system was originally a method of information filtering, a method for filtering information as a result of too much information on the internet and the media[2]. This user model is then used by the computing system to filter out so much information available and will produce recommendations to be presented to users[3]. The system for recommending scholarships is a system that serves to help LBWH administrators in selecting candidates for scholarships using TOPSIS method.

II. PURPOSE

The objectives to be achieved by the authors in this study are as follows:

1. Building a support system for decision making for scholarships to participants' new students based on predetermined criteria at the YPP Wahid Hasyim.

2. Implementing TOPSIS on the system that will made.

III. METHODOLOGY

A. Preliminary Study

In the preliminary study, which was the main target in this study is to examine the use of the TOPSIS method in the Fuzzy Multiple Attribute model Decision Making (FMADM).

FMADM is a method used to find optimal alternatives from a number of alternatives with certain criteria[4]. This method is used as a method decision making for scholarship.

B. Data Collection Phase

1) Literature Study

The method of data collection is done through reading and studying references in the form of scientific journals, theses, and books. Internet facilities are also used for media as searching for data or information published in cyberspace related to objects research.

2) Field Study

The method of data collection is done by direct review object problems, and collect information from relevant parties by observation and interview.

C. Software Development

1) Analysis of System Requirements

At this stage the analysis of the system requirements needed to facilitate the development process the system. This stage includes the analysis of the current business process running, problem analysis, proposal system, and functional requirements analysis.

2) System Interface Design

This stage is the process of designing a system display adjusted to the results of the needs analysis that has been carried out at the stage previous.

3) System Implementation

This is a system embodiment stage that comes from integration between system design that has been created using the PHP programming language and database design using MySQL. And the application of calculations using the TOPSIS method is carried out at this stage.

4) System Testing

It's the testing phase of the system that has been made, with the purpose of knowing the feasibility and disadvantages of the system[5]. Results of this stage is used as an evaluation material to make improvements and additions to the system that has been built.

5) System Maintenance

This is the last step in making a system (software), where the system that has been made can experience changes and addition according to user requests.

IV. RESULT AND DISCUSSION

A. System Description

The scholarship recommendation system is a software which was built to help administrators or selection teams from the Institute Wahid Hasyim Scholarship in selecting prospective scholarship recipients provided by the foundation. Selection is based on the results of calculations by using several predetermined criteria.

The calculation process using the TOPSIS method begins with determine the criteria for each scholarship available and give weight for each of these criteria. Then the registrant team consists of counseling teachers from each madrasa, register their students and give criteria values based on the destination path. Furthermore, the value of all scholarship applicants is processed and calculated using TOPSIS method to produce preference values for each applicant.

B. System Input

The value entered is the result of the criteria for scholarship applicants, both those entered by the teacher and the administrator. Value that has been entry, will be stored in the system and grouped according to the scholarship which is aimed. After all applicant values are stored in the system, then it will have judged by the administrator or administrator of LBWH. Assessment is based on scholarships intended by scholarship applicants.

C. System Output

Output (output) of the system of recommendation for scholarship is in the form of scholarship recipient recommendations are sorted by preference values the largest to the smallest of each available scholarship. After this stage the decision to award a scholarship will be submitted to the foundation, as scholarship organizer.

D. Assessment of Scholarship Applicants

The assessment of scholarship applicants is carried out by the TOPSIS method through several stages, starting from normalizing the decision matrix to the ranking stage[6]. Appraisal of scholarship applicants on this system is based on five criteria, which of these criteria can be different on each scholarship. So that the administrator team can determine what criteria will be given to each scholarship dynamically.

E. TOPSIS Method Calculation Results

Recommendation system for awarding scholarships at the Pondok Pesantren Foundation Wahid Hasyim uses TOPSIS. Data processed is the criteria determined by the scholarship selection committee or LBWH when opening new scholarship opportunities. So the criteria between each scholarship can be different according to needs.

The process of awarding scholarship recipients begins with register the scholarship applicants, either by each madrasah teacher or directly by the administrator. When registering a scholarship applicant, counseling teachers also inserts applicant's value based on the same criteria. After data from some complete scholarship applicants, the next step is make a selection.

The calculation of this selection using TOPSIS method by finding the closest distance to the ideal positive solution and the farthest distance from the negative ideal solution. Or in broad outline is the comparison between the value of individual criteria each applicant with the weight of the intended scholarship.

For example, here are two selection processes for the type of scholarship different:

1. *Beasiswa Miskin* (Scholarship for Poor People) Selection Process (BSM)

For example, here are two selection processes for the type of scholarship different:

The criteria for this scholarship are shown in Table I below.

TABLE I. BSM CRITERIA

Code	Criteria	Criteria Type
C1	Total Parent Income (JPO)	Cost
C2	Number of Parent Dependents (JTO)	Advantage
C3	Shelter Distance (JTT)	Cost
C4	Average National Examination (UN)	Advantage
C5	Ability to Stay in a Dormitory (US)	Advantage

Preference weight given for each criterion on this scholarship shown in Table II below.

TABLE II. TABLE WEIGHT OF BSM CRITERIA

Code	Criteria	Weight
C1	Total Parent Income (JPO)	5
C2	Number of Parent Dependents (JTO)	3
C3	Shelter Distance (JTT)	4
C4	Average National Examination (UN)	2
C5	Ability to Stay in a Dormitory (US)	5

Weight values are determined by a scale of numbers 1 - 5 based on the level interests of existing criteria.

Alternatives (applicants) for BSM that will be assessed by the Administrator (officers) as many as three people from different madrasas. The following Table III shows the alternative (applicant) of BSM.

TABLE III. TABLE OF BSM APPLICANTS

Code	Name of Applicant	Madrasa
A1	Ahmad Sabilirrosyad	MTs Wahid Hasyim

A2	Siti Hamidah Hasanah	MTs Wahid Hasyim
A3	Muhammad Nur Huda	MI Wahid Hasyim

TABLE IV.   TABLE OF BSM APPLICANT VALUE

Code	C1	C2	C3	C4	C5
A1	5	2	1	4	1
A2	5	1	1	3	1
A3	5	3	1	4	1

The following is the assessment process for the three alternatives on BSM scholarships:

1) Forma weighted normalized decision matrix

$X1 = \sqrt{5^2 + 5^2 + 5^2}$ $R23 = \frac{1}{1,732} = 0,577$

$= 8,66$ $R11 = \frac{1}{1,732} = 0,577$

$R11 = \frac{5}{8,66} = 0,577$ $X4 = \sqrt{4^2 + 3^2 + 4^2}$

$R21 = \frac{5}{8,66} = 0,577$ $= 6,403$

$R31 = \frac{5}{8,66} = 0,577$ $R14 = \frac{4}{6,403} = 0,625$

$X2 = \sqrt{2^2 + 1^2 + 3^2}$ $R24 = \frac{3}{6,403} = 0,469$

$= 3,74$ $R34 = \frac{4}{6,403} = 0,625$

$R12 = \frac{2}{3,74} = 0,535$ $X5 = \sqrt{1^2 + 1^2 + 1^2}$

$R22 = \frac{1}{3,74} = 0,267$ $= 1,732$

$R32 = \frac{3}{3,74} = 0,802$ $R15 = \frac{1}{1,732} = 0,577$

$X3 = \sqrt{1^2 + 1^2 + 1^2}$ $R25 = \frac{1}{1,732} = 0,577$

$= 1,732$ $R35 = \frac{1}{1,732} = 0,577$

$R13 = \frac{1}{1,732} = 0,577$

$R = \begin{matrix} 0,577 & 0,535 & 0,577 & 0,625 & 0,577 \\ 0,577 & 0,267 & 0,577 & 0,469 & 0,577 \\ 0,577 & 0,802 & 0,577 & 0,625 & 0,577 \end{matrix}$

2) Give weighting to each criterion

$Y = \begin{matrix} 0.152 & 0.084 & 0.122 & 0.066 & 0.152 \\ 0.152 & 0.042 & 0.122 & 0.049 & 0.152 \\ 0.152 & 0.127 & 0.122 & 0.066 & 0.152 \end{matrix}$

3) Determine the ideal positive solution (y max) and negative ideal solution (y min)

$y1^+ = MAX (0,152 ; 0,152 ; 0,152) = 0,152$

$y1^+ = MAX (0,084 ; 0,042 ; 0,127) = 0,127$

$y1^+ = MAX (0,122 ; 0,122 ; 0,122) = 0,122$

$y1^+ = MAX (0,066 ; 0,049 ; 0,066) = 0,066$

$y1^+ = MAX (0,152 ; 0,152 ; 0,152) = 0,152$

$A^+ = (0,152 ; 0,127 ; 0,122 ; 0,066 ; 0,152)$

$y1^- = MIN (0,152 ; 0,152 ; 0,152) = 0,152$

$y1^- = MIN (0,084 ; 0,042 ; 0,127) = 0,042$

$y1^- = MIN (0,122 ; 0,122 ; 0,122) = 0,122$

$y1^- = MIN (0,066 ; 0,049 ; 0,066) = 0,049$

$y1^- = MIN (0,152 ; 0,152 ; 0,152) = 0,152$

$A^- = (0,152 ; 0,042 ; 0,122 ; 0,049 ; 0,152)$

4) Calculate distance with a positive ideal solution

$D1^+ = \sqrt{0 + 0,00178 + 0 + 0 + 0} = 0,0422$

$D2^+ = \sqrt{0 + 0,00712 + 0 + 0,00027 + 0} = 0,0859$

$D3^+ = \sqrt{0 + 0 + 0 + 0 + 0} = 0$

5) Calculate distance with a negative ideal solution

$D1^- = \sqrt{0 + 0,00178 + 0 + 0,00027 + 0} = 0,0452$

$D2^- = \sqrt{0 + 0 + 0 + 0 + 0} = 0$

$D3^- = \sqrt{0 + 0,00712 + 0 + 0,00027 + 0} = 0,0859$

6) Determine the preference value for each alternative

$V1 = \frac{0,0452}{0,0422+0,0452} = 0,518$ $V3 = \frac{0,0859}{0+0,0859} = 1$

$V2 = \frac{0}{0,0859+0} = 0$

From the results of manual calculations above, the alternative is A3 code has the highest preference value. These results are in accordance with the preference value calculated using a scholarship recommendation system built. The following Figures 1 and 2 show the criteria for each applicant and the results of calculations use a recommendation system.

Figure 1.   Value of BSM Applicant Criteria

Figure 2.   BSM selection results using the system

2.   *Beasiswa Tahfidz Unggulan* Selection Process (BTU)

The criteria for this scholarship are shown in Table V below.

TABLE V.   TABLE OF BTU CRITERIA

Code	Criteria Type	Criteria
C1	Total Parent Income (JPO)	Cost
C2	Number of Parent Dependents (JTO)	Advantage
C3	Average National Examination (UN)	Advantage
C4	Ability to Stay in a Dormitory (US)	Advantage
C5	Shelter Distance (JTT)	Cost

Preference weight given for each criterion on this scholarship shown in Table VI below.

TABLE VI.   TABLE WEIGHT OF BTU CRITERIA

Code	Criteria Type	Weight
C1	Total Parent Income (JPO)	4
C2	Number of Parent Dependents (JTO)	3
C3	Average National Examination (UN)	2
C4	Ability to Stay in a Dormitory (US)	5
C5	Shelter Distance (JTT)	5

Weight values are determined by a scale of numbers 1 - 5 based on the level interests of existing criteria.

Alternatives (applicants) for BTU that will be assessed by the Administrator (officers) as many as three people from different madrasas. The following Table VII shows the alternative (applicant) BTU.

TABLE VII.   TABLE OF BTU APPLICANTS

Code	Name of Applicant	Madrasa
A1	Ahmad Afandi	MA Wahid Hasyim
A2	Ilza Ananta	MA Wahid Hasyim

TABLE VIII.   TABLE OF BSM APPLICANT VALUE

Code	C1	C2	C3	C4	C5
A1	3	3	3	1	5
A2	4	2	4	1	4

The following is the assessment process for the two alternatives on BTU scholarships:

1)   Forma weighted normalized decision matrix

$X1 = \sqrt{3^2 + 4^2} = 5$ $R13 = \frac{3}{5} = 0,6$

$R11 = \frac{3}{5} = 0,6$ $R23 = \frac{4}{5} = 0,8$

$R21 = \frac{4}{5} = 0,8$ $X4 = \sqrt{1^2 + 1^2} = 1,414$

$X2 = \sqrt{3^2 + 2^2} = 3,6$ $R14 = \frac{1}{1,414} = 0,707$

$R24 = \frac{1}{1,414} = 0,707$

$R12 = \frac{3}{3,6} = 0,832$ $X5 = \sqrt{5^2 + 4^2} = 6,4$

$R22 = \frac{2}{3,6} = 0,555$ $R15 = \frac{5}{6,4} = 0,781$

$X3 = \sqrt{3^2 + 4^2} = 5$ $R25 = \frac{4}{6,4} = 0,625$

$$R = \begin{matrix} 0,6 & 0,832 & 0,6 & 0,707 & 0,781 \\ 0,8 & 0,555 & 0,8 & 0,707 & 0,625. \end{matrix}$$

2)   Give weighting to each criterion

$$Y = \begin{matrix} 0.152 & 0.084 & 0.122 & 0.066 & 0.152 \\ 0.152 & 0.042 & 0.122 & 0.049 & 0.152 \\ 0.152 & 0.127 & 0.122 & 0.066 & 0.152 \end{matrix}$$

3)   Determine the ideal positive solution (y max) and negative ideal solution (y min)

$y1^+ = MAX (0,126 ; 0,168) = 0,168$

$y2^+ = MAX (0,131 ; 0,088) = 0,131$

$y3^+ = MAX (0,063 ; 0,084) = 0,084$

$y4^+ = MAX (0,186 ; 0,186) = 0,186$

$y5^+ = MAX (0,205 ; 0,164) = 0,205$

$A^+ = (0,168 ; 0,131 ; 0,084 ; 0,186 ; 0,205)$

$y1^- = MIN (0,126 ; 0,168) = 0,126$

$y2^- = MIN (0,131 ; 0,088) = 0,088$

$y3^- = MIN (0,063 ; 0,084) = 0,063$

$y4^- = MIN (0,186 ; 0,186) = 0,186$

$y5^- = MIN (0,205 ; 0,164) = 0,164$

$A^- = (0,126 ; 0,088 ; 0,063 ; 0,186 ; 0,164)$

4)   Calculate distance with a positive ideal solution

$D1^+ = \sqrt{0,00177 + 0 + 0,00044 + 0 + 0} = 0,0471$

$D2^+ = \sqrt{0 + 0,00192 + 0 + 0 + 0,00169} = 0,0601$

5) Calculate distance with a negative ideal solution

$$D1^- = \sqrt{0 + 0{,}00192 + 0 + 0 + 0{,}00169} = 0{,}0601$$

$$D2^- = \sqrt{0{,}00177 + 0 + 0{,}00044 + 0 + 0} = 0{,}0471$$

6) Determine the preference value for each alternative

$$V1 = \frac{0{,}0601}{0{,}0471 + 0{,}0601} = 0{,}56059$$

$$V2 = \frac{0{,}0471}{0{,}0601 + 0{,}0471} = 0{,}43941$$

From the results of calculations manually above, the alternative is code A1 has the highest preference value. These results are in accordance with the preference value calculated using a scholarship recommendation system built. The following Figures 3 and 4 show the criteria for each applicant and the results of calculations use a recommendation system.

Figure 3. Value BTU Applicant Criteria

Figure 4. BTU selection results using the system

F. System Test Results

Testing in this system involved ten respondents from the agency YPP Wahid Hasyim and students from various universities in Yogyakarta.

The results of testing system functionality using the alpha test indicate that 100% of system functionality can run. From these results it can be concluded that testing the functionality of the system declare a system that is made feasible to use.

The results of testing the interface and accessing the produce as much as 65.15% of respondents stated strongly agree with navigation and system interface and 34.85% agree with navigation and interface system. Based on the results above, it can be concluded that this system has easy access and attractive interface.

Testing the system content for the admin resulted 88.89% agreeing strongly to the system content and 11.11% agree to the system content. To test system content for 83.33% of respondents who strongly agreed the page views of the teacher and 16.67% agreed to the display teacher's page. While testing system content for students produces as much as 100% strongly agrees to the design of student page views. From the results of stesting the system content for admin, counseling teachers and students it can be concluded that the content of the recommendation system is in accordance with expectations and needs of all system users.

Based on the results of all tests, namely testing functionality system, testing interfaces and accessing and testing system content for admin, teacher and student, it can be concluded that the recommendation system scholarship at Wahid Hasyim Islamic Boarding School in Yogyakarta use the Technique for Order Preference method by Similarity to Ideal Solution (TOPSIS) is suitable for use. But there needs to be a system development further to get optimal results.

V. CONCLUSION

Based on the results of research and testing systems for giving recommendations scholarships for new students at YPP Wahid Hasyim Yogyakarta that has been done by the author and adjusted to the purpose research, then some conclusions can be taken as follows:

1) This research succeeded in designing and creating a recommendation system giving scholarships to new students at YPP Wahid Hasyim Yogyakarta uses TOPSIS is based on criteria different for each scholarship. This is based on test results on system functionality using alpha test shows 100% results.

2) This research has succeeded in making a recommendation system that is easy to use with an attractive appearance. Evidenced by the results of testing interface and system access that shows as much 65.15% of respondents stated strongly agree and 34.85% agreed to interface and access to the scholarship awarding system.

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