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*International Conference on Informatics
Engineering, Science & Technology*

May 9th, 2018
Bandung - Indonesia

Published by :

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International Conference on Informatics,
Engineering, Science and Technology

Challenges of Science and Technology in the 21st Century

Universitas Komputer Indonesia

9 May 2018

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International Conference on Informatics,
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Date : 9 May 2018

Venues : Grand Tjokro Hotel
Bandung - Indonesia

Organizer :
UNIVERSITAS KOMPUTER INDONESIA

Publication :
IOP Indexed by Scopus

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[ABS-48]

Construction Industry Project Planning Information System

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Abstract

The planning processes in construction industry nowadays develop the project management plan and the projects documents to carry out the project. The system being built is purposed to help project manager do project planning such as analyse risks probability and risks impact on projects using Probability Impact Matrix (PIM), and for project scheduling by showing the relationship between activities using Precedence Diagramming (PDM) method in order to project manager know the optimal project timing estimation. Based on the analysis and the results of system testing already done, it can be concluded that the system could help the project manager in identifying the risks that are likely to negatively affect project implementation, and help project manager in scheduling project. The cause of delay in project are there are no risk recorded, ignoring the risks that could have negative impact on the implementation of project, and there are no risk handling, and then the scheduling done by the project manager did not show the specific relationship between the project activity. Then system is expected could help project managers to implement monitoring and controls in project execution.

Topic: 1. Informatic and Information System

[ABS-50]

Computational Model of Student Competency Analysis in *Fuzzy Topsis* Method

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Abstract

In this research is purposed to predict student level competence in sustainability learning through vocational school. Measuring student competence can use a statistical method or intelligent computing process. One method in intelligent computing process is *Fuzzy Topsis*. An existing problem in this research is every process in evaluation student competence is calculated by mean measure. Challenging process in evaluation competency is use *Fuzzy Topsis* method. In enrolment *Fuzzy Topsis*, some variables are needed such as report, psycho-test, and teacher recommendation. Result of this research is level of student competency major in vocational schools. Using the data for 270 students, *Precision* test has calculated 75.60% and *Recall* test has 96%. This percentage is gained by calculate confusion matrix that differentiate between competence and not competence student level. Impact of this research is competency process can be efficient and effective on processing by *Fuzzy Topsis*. Other impact is measuring competency can be simple and dynamic than conventional method that used simply mean measure.

Topic: 1. Informatic and Information System

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To cite this article: A Nursikuwagus *et al* 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **407** 012095

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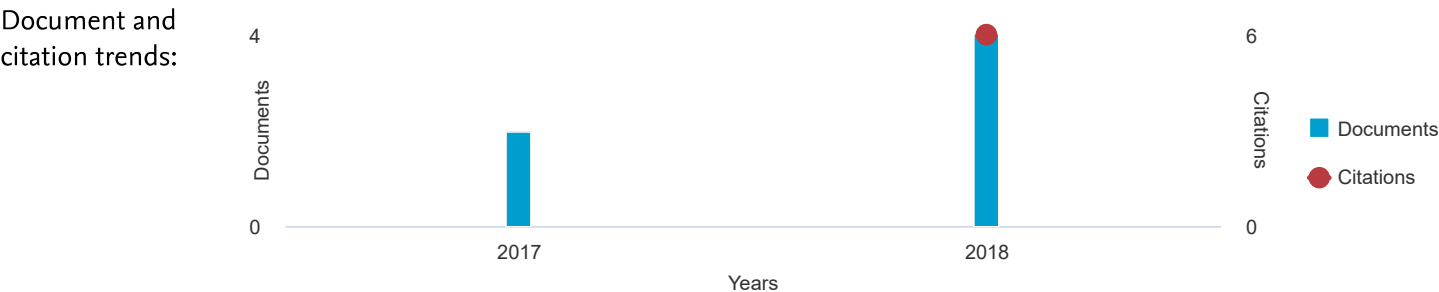
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RELX

Computational model of student competency analysis in *fuzzy topsis* method

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Abstract. In this research is purposed to predict student level competence in sustainability learning through vocational school. Measuring student competence can use a statistical method or intelligent computing process. One method in intelligent computing process is Fuzzy Topsis. An existing problem in this research is every process in evaluation student competence is calculated by mean measure. Challenging process in evaluation competency is use Fuzzy Topsis method. In enrolment Fuzzy Topsis, some variables are needed such as report, psycho-test, and teacher recommendation. Result of this research is level of student competency major in vocational schools. Using the data for 270 students, Precision test has calculated 75.60% and Recall test has 96%. This percentage is gained by calculate confusion matrix that differentiate between competence and not competence student level. Impact of this research is competency process can be efficient and effective on processing by Fuzzy Topsis. Other impact is measuring competency can be simple and dynamic than conventional method that used simply mean measure.

1. Introduction

In intelligence process, one method has been applied is *Fuzzy Topsis*. *Fuzzy Topsis* is part of soft computing method. Hence, using of soft computing method is direct to solve problem in *Data Mining* concept [1]. Processing data in intelligence process is making *precision* and valid to interpret pattern of context. It is hard to solve the problem using hard computing. Since, hard computing is using traversal method and fire match one by one to gain the solution. It is one reason why hard computing is rarely used in many research.

Challenging application in data mining process is measure student competency level at Vocational School. It is activity to separate student who has competency in appropriate skill. Many processes have succeeded to make decisions using Data Mining method [1]. One of challenging process in data mining is mining information by using Fuzzy Topsis. Many papers have been proposed about Fuzzy Topsis. They have been explained about Fuzzy Topsis in several activities. Concept mining in Fuzzy Topsis has proposed by [2-9]. Mahmud Yavuz [10] has explained about applying Fuzzy Topsis in selection equipment problem. In paper [2,8], many fields have been completed to make solution with Fuzzy Topsis. However, in [2-8] Fuzzy Topsis is just used three to four parameters. The result is not applied in complex parameter yet. Indeed in measuring student competency at vocational school is not solved yet.



Following research that have completed [1-8], this research is directed to make solve a problem about measuring student competence level. Student competency is formulated by Fuzzy Topsis method. Result of this research is provided another measure which purposed measurement of 270 student competency in Fuzzy Topsis [1]. This research has been also provided about Precision and Recall in Fuzzy Topsis.

2. Methodology

2.1. Fuzzy topsis method

Fuzzy Topsis method has proposed by Hwan and Yoon [6] to solve problem in *MCDM (Multiple Objective Decision Making)* process. *Fuzzy Topsis* is ideal choice solution. *Fuzzy Topsis* has had simple formal mathematics concepts, and strategy to accomplish their process. This strategy is directed to step forward as follows normalized matrix decision, weighted normalized matrix, gain positive and negative solution matrix, distance between positive and negative solution, and gain preference value for each alternative. Process in *Fuzzy Topsis* is needed to calculate performance in rating for each alternative and criteria.

2.1.1. Created Normalized Matrix or Relation Matrix. *Normalized Matrix* is value that ordered in row and column. *Normalized matrix* is composed from relation between parameters therein. We have constructed normalize matrix by formula (1) [6].

$$r_{ij} = x_{ij} \left[\sum_{i=1}^m x_{ij}^2 \right]^{-\frac{1}{2}} \quad ; i=1,2,\dots,m \text{ and } j=1,2,\dots,n \quad (1)$$

r is item in row **i** and column **j** ; **x** is every value in parameters that composed by rows 1 to **i** and columns 1 to **j** [2-8].

2.1.2 Gaining Weighted Normalized Matrix. *Weighted normalized matrix* is an integer value to give weight for each parameter [6]. This design is tailored by human perception about concern for each parameter. An example, if the research design has five parameters, we can write value for weighted at formula (2) [6].

$$w_{[ij]} = [x_{[ij]} \times r_{[ij]}] \quad i = 1,2,\dots,m \quad ; \quad j = 1,2,\dots,n \quad (2)$$

2.1.3. Gaining Positive and Negative Solution Matrix. Step forward after obtain weighted value is enrolling positive and negative solution matrix. We have created a notation to separate value between positive solution (A^+) and negative solution (A^-). In this step, *Fuzzy Topsis* is used normalize weighted matrix to make rating (Y_{ij}). This formula can be written at formula (3), (4), (5), (6), and (7) [6].

$$y_{ij} = w_i r_{ij} \quad ; \quad \text{With } i=1, 2, \dots, m; \text{ and } j=1, 2, \dots, n \quad (3)$$

$$A^+ = (y_1^+, y_2^+, \dots, y_n^+) \quad (4)$$

$$A^- = (y_1^-, y_2^-, \dots, y_n^-) \quad (5)$$

$$y_j^+ = m \quad i y_i \quad ; \quad i \quad j \quad i \quad b \quad a \quad (6)$$

$$y_j^- = m \quad i y_i \quad ; \quad i \quad i \quad i \quad c \quad a \quad (7)$$

2.1.4. Distance between Positive and Negative Solution. Solution for each rating can be remarked between alternative and ideal solution. Formulating the distance can be written at formula (8) and (9) [6].

Distance between Ai and positive ideal solution D_i^+ :

$$D_i^+ = \left[\sum_{j=1}^n y_j^+ - y_{ij} \right]^{\frac{1}{2}}; \quad i = 1, 2, \dots, m. \quad (8)$$

Distance between Ai and negative ideal solution D_i^- :

$$D_i^- = \left[\sum_{j=1}^n y_j^- - y_{ij} \right]^{\frac{1}{2}}; \quad i = 1, 2, \dots, m \quad (9)$$

2.1.5. Gaining preference value for each alternative. In this step forward after distance measuring, we are calculated preference value for each (Vi). Formulating preference can be written at formula (10) [6].

$$V_i = D_i^- [D_i^- + D_i^+]^{-1}; \quad i = 1, 2, \dots, m. \quad (10)$$

Rating (Vi) is shown as a high competency in major alternative selected (Ai) that have a higher preference than the other.

2.2. Precision and recall

Step forward from gaining rating is validation of the formula that is suitable for the case. We have used *Precision* and *Recall* method that has significant to problem. *Precision* and *Recall* that have used are defined from [7]. We have used formula (11) and (12).

$$R = T [T + F]^{-1} \quad (11)$$

$$P = T [T + F]^{-1} \quad (12)$$

Calculating *Precision* and *Recall* can be composed by confusion matrix. Confusion matrix content is value from how many result is corrected with real condition. Matrix can be constructed at Table 1.

Table 1. Composition confusion matrix.

	Condition : A	Not A
Test says accepted A	True positive (TP)	False positive (FP)
Test says accepted not A	False negative (FN)	True negative (TN)

3. Results and discussion

3.1. Results

In this research, we have used 270 rows of data [1]. Data have been taken from observed into the field [1]. At vocational school in Indonesia, every school has regulation to accept their student. Prerequisite has to be achieving from every student and accepting students should have to pass examine. There are several parameters that have fulfilled by candidate [10]. These parameters are determined from the school regulation such as national exam, psychology test, interview, grade report, body test, competency test. These parameters that have calculated are executed by Fuzzy Topsis [11].

3.1.1. Dataset. Following data record can be seen as *dataset* that have taken from observation. Showing a process, we have shown three *dataset* as sample. At Table 2 shows an example *dataset* with parameters therein in Table 2.

Table 2. Example *dataset* that have gained from survey at Vocational School.

No	Name	National Exam	Competency (x2)	Grade Report (x3)	Body Test (x4)	Interview (x5)	Psychology Test (x6)
1	Dadang Wasisto	30.74	83.33	79.84	80.00	85.00	50.00
2	Tri Andi Kusumah	28.21	73.33	79.52	80.00	85.00	80.00
3	Ani Suryani	31.66	83.33	79.16	70.00	65.00	80.00

3.1.2. *Normalized matrix.* Step first in *Fuzzy Topsis* is gained normalize matrix. At Table 3, we are used formula (1) to gain relation matrix or normalized matrix in Table 3.

Table 3. A result from calculating normalized matrix by formula (1) as relation matrix r_{ij}

No	Name	x1	x2	x3	x4	x5	x6
1	Dadang Wasisto	2.04	5.73	4.91	5.12	5.73	2.10
2	Tri Andi Kusumah	1.72	4.44	4.87	5.12	5.73	5.38
3	Ani Suryani	2.16	5.73	4.83	3.92	3.35	5.38

At Table 3, acquisition of the test score has ran from the use of formula (1). Value in column x1, presented by calculating $x_{[1,1]}$ at Table 2 that has divided by the root of the number of values in column x1. Result for $r_{[1,1]}$ is 2.04. An example calculation is performed as follows: $r_{[1,1]} =$

$$x_{[1,1]} \left[\sum_{i=1}^{270} [x_{[i,1]}]^2 \right]^{-\frac{1}{2}} = r_{[1,1]} = 30.74 \left[[30.74]^2 + [28.21]^2 + \dots + [33.22]^2 \right]^{-\frac{1}{2}} = 2.04$$

3.1.3. *Gaining weighted normalized matrix.* Every weight in $[i,j]$ is got from times $x_{[i,j]}$ and $r_{[i,j]}$. Following table 4 is an example determines weighted value. At Table 4 is resulted from execution formula (2) in Table 4.

Table 4. An example result for weighted normalized matrix. Y symbol is parameter that has calculated to weight normalized matrix (Matrix w).

No	Name	(Y1)	(Y2)	(Y3)	(Y4)	(Y5)	(Y6)
1	Dadang Wasisto	62.60	477.51	392.10	409.53	487.10	105.05
2	Tri Andi Kusumah	48.39	325.41	387.40	409.53	487.10	430.27
3	Ani Suryani	68.45	477.51	382.16	274.36	217.82	430.27

At Table 4, the result is gained from calculating weighted with formula (2). As an execution, process is following like: $w_{[1,1]} = x_{[1,1]} \times r_{[1,1]} = 30.74 \times 2.04 = 62.60$; for column Y1

We have completed to end of dataset as many as 270 in columns Y1. For Y2 until Y6 is same process like Y1.

3.1.4. *Gaining Positive and Negative Solution Matrix.* Step forward after perform weighted normalize matrix is calculate to solution in positive and negative respectively. We have used formula (3) to collect be A^+ (alternative positive) and A^- (alternative negative). A^+ and A^- , collecting in one matrix, is called $y_{[j]}^+$ and $y_{[j]}^-$. As an execution for A^+ and A^- , was can be written as follow:

$$y_1^+ = \max[\text{column}(Y1)] ; y_2^+ = \max[\text{column}(Y2)] ; y_3^+ = \max[\text{column}(Y3)] .$$

$$A^+ = [y_{[1]}^+ ; y_{[2]}^+ ; \dots ; y_{[6]}^+] = [79.01 ; 784.57 ; 549.01 ; 583.11 ; 487.10 ; 430.27] .$$

$$y_1^- = \min[\text{column}(Y1)] ; y_2^- = \min[\text{column}(Y2)] ; y_3^- = \min[\text{column}(Y3)] \quad A^- = [y_{[1]}^- ; y_{[2]}^- ; \dots ; y_{[6]}^-] = [13.84 ; 22.28 ; 157.91 ; 99.98 ; 217.82 ; 105.05]$$

3.1.5. Distance between Positive and Negative Solution. Distance is counting how far differ between positive and negative solution. Computing distance is used formula (8) and (9). We are proposed D symbol for symbolizing distance, D^+ for solution distance positive, and D^- for solution distance negative. Running process shows an example execution from formula (8) and (9) in Table 5.

$$D_i^+ = \left[\sum_{j=1}^6 y_j^+ - y_{[i,j]} \right]^{\frac{1}{2}} ; D_i^- = \left[\sum_{j=1}^6 y_{[i,j]} - y_j^- \right]^{\frac{1}{2}}$$

$$D_1^+ = \left[(y_1^+ - y_{[1,1]}) + (y_2^+ - y_{[1,2]}) + \dots + (y_6^+ - y_{[1,6]}) \right]^{\frac{1}{2}} = [(79.01 - 62.60) + (784.57 - 477.51) + \dots + (430.27 - 105.05)]^{\frac{1}{2}} = 31.29$$

$$D_1^- = \left[(y_{[1,1]} - y_1^-) + (y_{[1,2]} - y_2^-) + \dots + (y_{[1,6]} - y_6^-) \right]^{\frac{1}{2}} = [(62.60 - 13.84) + (477.51 - 22.28) + \dots + (105.05 - 105.05)]^{\frac{1}{2}} = 8.81$$

Table 5. An Example result positive solution.

A	Name	Y1	Y2	Y3	Y4	Y5	Y6	D_i^+
1	Dadang Wasisto	16.41	307.06	156.91	173.57	0.00	325.22	31.29
2	Tri Andi Kusumah	30.62	21.43	161.61	173.57	0.00	0.00	19.68
3	Ani Suryani	10.57	17.52	166.84	308.75	269.28	0.00	27.80

3.1.6. Gaining preference value for each alternative. Finalization process has determined preference value for each alternative. Preference is gained from formula (10). We have counted every alternative from A1 until A270. An example execution formula (10) can be seen at Table 6.

$$V_1 = D_1^- \left[D_1^- + D_1^+ \right]^{-1} = 8.81 [8.81 + 31.29]^{-1} = 0.220 ; \text{Preference for alternative A1}$$

Table 6. An Example preference in every alternative A.

A	Name	D_i^+	D_i^-	V_i
1	Dadang Wasisto	31.29	8.81	0.220
2	Tri Andi Kusumah	19.68	9.51	0.326
3	Ani Suryani	27.80	8.66	0.237

3.2. Discussion

Fuzzy Topsis has a simple execution in process. Every step is just following execution the formula. Subsection before, it has proven that *Fuzzy Topsis* gives simple calculation [2-9]. Values at table have shown strictly computation with numeric manner [11]. At Table 4, information that content at Table 4 is real value. We have taken from survey at Vocational School in Indonesia [1]. We are just to prove steps in *Fuzzy Topsis*. We are thinking is the same in process. 270 dataset or more is the same of process. We are just considering effective algorithm to process big data [8].

Measurement effectively process, we used *Precision* and *Recall*. In formula (11), we have written formulation from [9]. At Table 7 shows a result from inheritance process from calculation every prediction. We have proposed some symbols such as TP (True Positive), FP (False Positive), FN (False Negative), and TN (True Negative). Using confusion matrix is displaying result that classify where the result is same and not as condition. Assisting confusion matrix, it is process for calculating *Precision* and *Recall* like shown at Table 7.

Table 7. Confusion matrix has taken from final result.

	Condition : Accepted	Not Accepted
Result accepted	TP = 192	FP = 8
Result Not accepted	FN = 62	TN = 8

$$Precision = TP [TP + FN]^{-1} = 192 [192 + 62]^{-1} = 0.756$$

$$Recall = TP [TP + FP]^{-1} = 192 [192 + 8]^{-1} = 0.96$$

In information retrieval, *Recall* in a process is 0.96. It means that document we are used has relevant 96% in *Fuzzy Topsis* [7,8]. On the other hand, *Precision* is 0.756 that is *dataset* only 75.6% alignments within the context [6-8], that result can be written at Table 8.

Table 8. Result Comparison in Fuzzy Method within *Precision* and *Recall* as much as 270 *dataset*.

Method	<i>Precision</i>	<i>Recall</i>
Fuzzy Mamdani [1]	75.63%	90%
<i>Fuzzy Topsis</i>	75.60%	96%

4. Conclusion

Implementation *Fuzzy Topsis* in measuring student competency is effective process. Simplicity in execution has made *Fuzzy Topsis* suitable for *dataset* that contents numeric values. In parameters therein such as national exam, competency, grade report, body test, interview, and psychology test are made success in predicting student competency. In 270 *dataset*, we conclude that *Fuzzy Topsis* is able reach 75.60% in precision. In recall, *Fuzzy Topsis* reach 96%. Meaning of precision that *Fuzzy Topsis* can be executed and resulted 75.60% valid data, and meaning of recall that *Fuzzy Topsis* is able process in document as much as 96% significant document. Comparing with other Fuzzy Method, we have concluded that in Fuzzy term almost the same values in ranging 90% - 96% in Recall. Likewise in precision, the result has the same ranging between 75% - 77%. Measuring competency can be simple and dynamic than conventional method that used only averaging value.

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