Decision Support System to Help in Determining the Study Program Concentration for Higher Education Institution

Tanty Oktavia, Evaristus Didik Madyatmadja

School of Information Systems, Bina Nusantara University, Jl. K.H. Syahdan No. 9 Palmerah Jakarta Barat 11480, Indonesia

toktavia@binus.edu

Abstract—The process of decision support for higher education institution to determine the concentration of study program becomes a significant problem because the student needs to analyse their interest, ability, and other factors as the qualification. A mistake in decision-making will be detrimental to the students' education level, and it can even affect their future. This is a problem that occurs every semester, not only within the scope of the faculty but also in the university. Therefore, this research proposes a model to ease the higher education institution in determining a concentration of student using AHP and TOPSIS method. AHP method is a decision support system that can give weight on criteria of concentration and test its consistency. This method is to give weight for each criterion of student concentration majoring in Information System. TOPSIS method has a concept that the appropriate alternative has the shortest distance with a positive ideal solution and has the farthest distance with a negative ideal solution. Moreover, the criteria for choosing the concentration are multiple intelligences, GPA, course score, and TOEFL score. Weights obtained from AHP become the input value in the TOPSIS method in sorting the alternatives to be selected. Then, the result of the sorting is being calculated for its accuracy level. Based on the calculation of 93 sample of student's concentration with AHP-TOPSIS method, 62 data are the same, so it results in the accuracy of 67%. An application with AHP-TOPSIS method can be used to help the university management in determining the concentration at Information System major for XYZ University.

Index Terms—Concentration; Decision Support System; AHP-TOPSIS.

I. INTRODUCTION

Every new term, the higher education offers streams/concentration that can be chosen by students to boost their competency based on their preferred interests, competency, and other supporting factors [1]. This period has become a difficult situation faced by the students and university because the process to decide a suitable concentration is not easy [2]. It needs many considerations to determine a suitable concentration because it will affect the student for long-term [3]. A university as an educational institution has a responsibility to deal with this situation, because every semester, many students will need to consult the person in charge in the department to identify the prospective concentration for them [4]. Determining the concentration in a study program will affect each course they take in the next semester. Once they take a wrong decision, it will affect the students until their final semester. So, the uncertainty in determining the concentration of a study

program often strikes the students. Moreover, if the student chooses an unsuitable concentration, they will seek the solution from their university. This is a difficult situation for the university if most of the students want to change the concentration; it will affect the learning process. Based on this problem, this research proposes an integrated solution of the process to determine the concentration program that will be chosen by the students. Even though the final decision has to be made by students themselves, the system can certainly give additional information to students about the appropriate decision based on the supporting data that has been mapped to the system before. The process of choosing a concentration needs to be facilitated by a party that can help and guide [5] students in determining the right concentration with the competency and ability of the students. The administrator of the program is responsible for facilitating the students in choosing their concentration. However, there are many criteria used for the consideration in choosing the concentration [6]. These criteria are based on the aspects of mathematical and logical intelligence, spatial intelligence, bodily-kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, naturalistic intelligence, and existential intelligence, and also it uses Grade Point Average (GPA), TOEFL score, and specific subjects' scores.

In determining the concentration of a student, XYZ University still uses the manual way. It takes a long time, and the accuracy level is also not maximised. The use of the information technology in education can help ease the problems [7]. Information technology can be used to help students to determine the concentration of a program based on the existing criteria. One way is using the decision-support system with the combination of AHP-TOPSIS [8][9]. AHP method is used to give weight on each criterion of the concentration and test its consistency [10]. Then, TOPSIS method is used to rank the concentration selection [11]. Furthermore, TOPSIS method has a concept that the chosen alternative is the alternative that has the shortest distance with the positive ideal solution and has the farthest distance with the negative ideal solution. In other words, the alternative with the highest score will be chosen as the concentrated solution of the student. To be able to use the decision-support application of AHP-TOPSIS method, there is a need to test the accuracy level [12] [13]. This research aims to construct a model of decision support systems to accommodate the selection process. This system will be able to determine an appropriate concentration of a program of Information

System students of XYZ University as a sample. So, the students can choose the right concentration based on the results of the system that uses AHP-TOPSIS method. Madyatmadja, E., D [14] states that several criteria must be determined to decide the purpose of Decision Support System. Those criteria need PNPM management to calculate the benefit and risk of that decision. Madyatmadja., E., D and Oktavia., T states that the information system decision support in determining the concentration of study program can help students, especially those of the advanced semester, to determine suitable concentrations according to their abilities and interests [15].

II. PROBLEM DEFINITION

From the questionnaire results from 116 Information Systems students at XYZ University, there are several problems faced by students related to the choice of concentration, which are:

i. There are students who felt that they take a wrong concentration. There is 17.2 % who felt do not fit their concentration, and 1.7% who felt incompatible with their selected concentration.

ii. There are students who are hesitant in determining their concentration, 78.4% of students felt lack of adequate information and do not know the suitable concentration.

With the developed system, it is expected that students were helped in determining a right concentration in Information System major. The expected problem solving is:

i. A model that is able to give a recommendation in selecting a concentration based on abilities.

ii. A model that is able to be developed to help students in choosing a concentration from time to time.

III. RESEARCH METHOD

A. Analysis Method

The first step is to collect the primary and secondary data used as materials for the analysis process. The activities that were done to collect primary data are:

i. Observation: This research was conducted by using a quantitative approach, which takes some samples from a population of Information System major at XYZ University. This process aims to get the understanding of the process of selecting concentration systems in general higher education.

ii. Questionnaire: After we get an overview of the selection process, we collect the questionnaires from the respondents involved in the process, which include the students', as well as the department, parents, and other academics, such as faculty and staff.

iii. Interview: According to the collected data, we conducted an in-depth interview with the person involved in the operational implementation process. The purpose is to explore the process of selecting a concentration of each sample at Information System major at XYZ University.

B. Design Method

This research aims to propose a design of a decision-making system in determining the concentration at higher education institutions. There are several steps in making the process, which are:

i. Selecting concentration processes through business design in Indonesia higher education, which is illustrated by using UML (Unified Modeling Language) diagram.

ii. AHP-TOPSIS method. This method is used to provide solutions for determining the concentration of Information System students in the XYZ University.

IV. DISCUSSION

A. AHP

Ranius, A., Y [16] proposes a method in a decision support system namely Analytical Hierarchy Process (AHP), which is a method to make decisions scientifically and rationally to provide a solution to multi-criteria and complex problem with a variety of alternatives.

1) Criteria

There are several criteria used in selecting the concentration, such as nine types of intelligence, GPA, the grade of the subject of Business Processes Information and Algorithms & Programming, and TOEFL.

i. Intelligence Criterion
This criterion is related to the type of intelligence possessed by the students. To determine this criterion, the questionnaire to the students was carried out. This criterion is important because it affects the concentration that will be selected by the students. This criterion consists of nine types of intelligence, namely linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalist and existential.

ii. GPA Criterion
This criterion is related to the cumulative grade of the students from the first semester to the third semester. This criterion is important because it is obtained from the student learning outcomes during the study.

iii. Subject Grade
This criterion is related to the subject grade that affects concentration, such as Algorithm & Programming (Algo) and Business Process Information (BPI). This criterion is necessary because Algo is closely related to the concentration of Applied Databases and BPI is closely linked to the Applied ERP. The grade must be at least B when applying for this concentration.

iv. TOEFL Criteria
This criterion is related to the fluency in English. This criterion is essential with regard to a particular concentration. A minimum TOEFL score of 500 if the student wants to enter the concentration of Applied Database and Applied ERP.

2) The Value of Interest Ratio Between the Criteria

The comparison value of criteria for intelligence, GPA, subject and TOEFL uses the comparative matrix method. Intelligence criteria are obtained from the aptitude test that includes nine types of intelligence, which consist of 10 questions for each concentration where students answer the choice of Yes or No. Then for GPA, subject grade, and

TOEFL score is obtained from a database stored in the XYZ University.

3) Alternative Data

Data concentration that becomes an alternative is the concentration available for Information Systems major in XYZ University, which is Applied Database concentration, Applied ERP, Business Intelligence, E-Business, and Strategic Information System.

4) Testing and Data Processing

AHP Data is obtained from a student who wanted to know the appropriate concentration while performing intelligence test. Then the test result will be counted together with the GPA, subject grade, and TOEFL to obtain its value which then will proceed to the stage of TOPSIS.

5) Calculation per Criteria

The results of the intelligence test of a student, GPA, subject grade and TOEFL are obtained through these steps:

Step 1: Equalizing the value of comparison criteria in the 1-10 range of the integer

Step 2: Create a pair of matrix from the value of comparison criteria

Step 3: Do the normalisation, by dividing the element with a total of the column

Step 4: Consistency test by multiplying the value with the matrix pair

Step 5: Finding the t-value by dividing the result in step 4 earlier by their respective value, then sum up the number, and then divided by the number of criteria.

Step 6: Calculate the Consistency Index (CI) by subtracting the t-value above with the quantity

Step 7: Calculate the Consistency Ratio (CR) by CI/RI.

The summary of the criteria value and criteria is shown in Table 1.

Table 1
Evaluation of Criteria Value and Criteria

Criteria	Criteria	Value
Intelligence	Ling	0.038
	Log	0.0506
	Spa	0.0506
	K-J	0.0506
	Mus	0.0506
	AP	0.0886
	IP	0.0886
	Nat	0.038
	Eksis	0.0633
GPA		0.1266
Subject	Algo	0.1139
	IPB	0.1266
TOEFL		0.1139

B. TOPSIS

Hwang, C., & Yoon, K [17] states that the Technique Order Performance by Similarity to Ideal Solution (TOPSIS) is based on the concept that the best alternative [18] selected does not only have the shortest distance from the positive ideal solution but also has the longest distance from the negative ideal solution.

The decision support method based on the concept that the best alternative does not only have the shortest distance from the positive ideal solution, but it also has the longest distance from the negative ideal solution [19]. To create a table of value is by conducting aptitude tests to students majoring in the single information system. Then from the result of the questionnaire, some students are screened and selected in accordance with their respective concentration. There are 16 students with the concentration of Applied Database, 20 students with the concentration of Applied ERP, 20 students with the concentration of Business Intelligence, 18 students with the concentration offered, and 19 students with the concentration of E-Business. The test will be used as a standard intelligence of each concentration. The standard of GPA of XYZ University students' graduation is 2.00 and the entry requirement for enrollment of Applied Database, and Applied ERP is 3.00. The concentration requirements of Applied Database are Algorithms and Programming must be at least B, and TOEFL scores above 500 whereas ERP of IPB subject must be at least B, and TOEFL score above 500. So, the standardisation of intelligence, GPA, courses and TOEFL is needed.

Table 2
Value of TOPSIS

	Value	%	Ranking
Oracle	0.5107	51.07	2
ERP	0.5504	55.04	1
BI	0.3681	36.81	4
SIS	0.4221	42.21	3
E-BIS	0.3488	34.48	5

The best alternative is the ERP because it has the highest value among other alternatives. In the major concentration system of the information system of XYZ University, there is a requirement for a particular concentration, and there is no requirement for regular concentration [20]. All this time the concentration recommendation was still made manually. However, this application is expected to help students to find information on the concentration, so that the students could pay more attention to the requirements that will be chosen later such as subject grade, GPA, and TOEFL, so the concentration selection errors that were often experienced by the students can be minimised.

As the final step of the application design, a test is conducted on 93 students of Information Systems of XYZ University to obtain the validity of the application. The following is the result table of the validity test:

Table 3
Validity Test Result

No	NIM	Concentration	Suitable	Recommendation	Valid/ Invalid
1	1601258083	DB	No	1. Applied ERP 2. Applied DB	Valid
2	1601219605	ERP	Yes	1. Applied ERP 2. Applied DB	Valid
3	1601236170	BI	Yes	1. Applied ERP 2. SIS	Invalid
4	1601232866	SIS	Yes	1. Applied ERP 2. Applied DB	Invalid
5	1601234120	BI	Yes	1. BI 2. Applied DB	Valid
6	1601218703	BI	Yes	1. SIS 2. ERP	Invalid
7	1601216660	E-Bis	Yes	1. BI 2. Applied DB	Invalid
8	1601252590	SIS	Yes	1. SIS 2. BI	Valid
9	1601235294	DB	Yes	1. Applied DB 2. Applied ERP	Valid
10	1601255711	BI	Yes	1. BI 2. Applied DB	Valid
11	1601246556	E-Bis	No	1. BI 2. E-Bis	Valid
12	1601252722	SIS	Yes	1. BI 2. Applied DB	Invalid
13	1501143683	DB	Yes	1. Applied DB 2. ERP	Valid
14	1601253403	SIS	Yes	1. SIS 2. Applied ERP	Valid
15	1401095941	BI	No	1. Applied ERP 2. SIS	Valid

NIM column is the students who do validity test, then the column of concentration is the current concentration or the concentration that had been taken. The suitable column is the student answers who feel suitable to the chosen concentration or not. Recommendation column is the top two suggestions for concentration suggested by the system. The validity was measured by looking at the table above. Recommendations are considered valid if:

1. The suitable column contains "Yes", and the concentration column is the same with recommendation column.
2. The suitable column contains "No", and the concentration column is different with recommendation column.
3. From the testing of 93 respondents, obtain the correct advice as many as 62 times. So, it can be concluded

that so far, the validity of the application provides a level of 67%.

V. CONCLUSION

Based on the research that has been conducted, the following conclusions can be drawn:

1. Based on the accuracy tests that have been done, it has 67% accuracy rate.
2. This decision support system needs to be further assessed because the validity and reliability cannot be guaranteed, it requires more samples.
3. After using this application, students can consult the department so that the chosen concentration really fits and able to support the students in the future.

REFERENCES

[1] Condrobimo., A., R, *Sistem Pendukung Keputusan untuk Penentuan Konsentrasi Studi dalam Penulisan Skripsi bagi Mahasiswa S1 Jurusan Ilmu Komunikasi Fakultas Isipol Universitas Gadjah Mada Yogyakarta*, Tesis Magister Manajemen Informasi UGM, 2005.
[2] Satzinger, J. W., Jackson, R. B., & D.Burd, S, *Systems Analysis and Design in a Changing World.* Boston: Course Technology, Cengage Learning, 2012.
[3] Putri, C. F, *Pemilihan Supplier Bahan Baku Kertas Dengan Model QCDFR Dan Analytical Hierarchy Process (AHP).* Widya Teknika 32-38, 2012.
[4] Rainer Jr., R. Kelly, and Casey G Cegielski, *Introduction to Information Systems.* Singapore: John Wiley & Sons, 2013.
[5] Ralph. M Stairs, and George W. Reynolds, *Fundamentals of Information Systems.* 7th United States of America: Course Technology Engage Learning, 2013.
[6] Watson, Richard T, *Data Management Databases and Organizations.* United States of America, 2006.
[7] Arnott, D, Pervan, G, A Critical Analysis of Decision Support Systems Research, *Journal of Information Technology vol 20, pp. 67–87., 2005.*
[8] Belanger, France, and Craig Van Slyke, *Information Systems for Business.* United States of America: John Wiley & Sons., 2012.
[9] Efrem G,. Mallach, *Decision Support and Data Warehouse Systems.* United States of America: McGraw-Hill/Irwin., 2000.
[10] Gardner, H, *Multiple Intelligences.* United States of Amerika: Basic Books, 2014.
[11] Laudon, Kenneth C, and Jane Laudon, *Management Information Systems.* 9th. United States of America: Pearson Prentice Hall., 2006.
[12] Merry, L., Ginting, M., & Marpaung, B. Jurnal Teknik dan Ilmu Komputer. *Pemilihan Supplier Buah dengan Pendekatan Metode Analytical Hierarchy Process (AHP) dan TOPSIS: Studi Kasus pada Perusahaan Retail*, 48-58, 2014.
[13] O'Brien, James and George M. Marakas. *Management Information Systems.* United States of America: McGraw-Hill/Irwin, 2010.
[14] Madyatmadja, E., D, Decision Support System Model to Assist Management Consultant in Determining the Physical Infrastructure Fund, *Journal of Application Technology and Information Technology Vol 62 No. 1, pages 269-274, 2014.*
[15] Madyatmadja., E., D dan Oktavia., T, *Decision Support System In Determining The Study Program Concentration In Higher Education Institutions.* The 4th International Conference on Information and Communication Technology, 2016.
[16] Ranius., A., Y, *Sistem Penunjang Keputusan Penetapan Dosen Pembimbing dan Penguji Skripsi dengan Metode AHP.* Universitas Bina Dharma Palembang, 2014.
[17] Hwang, C., & Yoon, K, *Multiple Attribute Decision Making.* Methods and Applications, 1981.
[18] Saaty, T. L, Int. J. Services Sciences. *Decision making with the analytic hierarchy process*, 83-98., 2008.
[19] Sukwadi, R, Yang, C.-C., & Benny. Jurnal Teknik Industri. *Integrasi Fuzzy AHP-TOPSIS dalam Evaluasi*, 25-32., 2014.
[20] Turban, E., Sharda, R., Delen, D, *Decision Support and Business Intelligence Systems.* 9th Edition. Prentice-Hall., Inc. Upper Saddle River. New Jersey, 2014.