

# Designing the Decision Support System to Determine the Major and Higher Education Institution based on Preferences of Prospective Students

Siti Supri Astutik<sup>a</sup>, Wandhansari Sekar Jatiningrum<sup>a,\*</sup>

<sup>a</sup> Industrial Engineering Department, Ringroad Selatan, Banguntapan, Bantul, 55166, Indonesia

\* Corresponding Author: [wandhansari.sekar@ie.uad.ac.id](mailto:wandhansari.sekar@ie.uad.ac.id)

## ARTICLE INFO

### Article history

Received July 23, 2023

Revised September 2, 2023

Accepted October 2, 2023

### Keywords

Higher education;

AHP;

MCDM;

DSS

## ABSTRACT

There are several factors considered by students toward determining the major and higher education institution. As a result, determining the best choices for further studies becomes difficult. Moreover, there are many choices of higher education. This study contributes to developing a decision support system (DSS) to help students determine the major and higher education institution considered several criteria based on Analytical Hierarchy Process (AHP). Several criteria and subcriteria were chosen by distributing 186 questionnaires to final grade students. Based on the result, criteria and subcriteria used were tuition fee, scholarship, infrastructure (library, classroom, laboratory, transportation, teaching staff), curriculum, quality (accreditation, study period, achievement), reputation, and international collaboration. According to these criteria and sub-criteria, a DSS was built to help students determine their major and higher education institution according to their preferences. The algorithm used was AHP, which was then built with Borland Delphi. Context Diagram, Data Flow Diagram (DFD), and Entity Relationship Diagram (ERD) were made as a guide to design the DSS. This DSS was tested using black box test, beta test and compatibility test with manual calculations. The black box test showed that the DSS has performed the functions according to the design. Later, the beta test resulted in a correctness score of 20.4, reliability of 16.8, usability of 25.5, which means they were in the very good category and integrity of 3.4, which means good. Meanwhile, based on manual calculations, the DSS provides output in accordance with the results of manual calculations. Finally, the DSS was proven to be used as a decision-making tool in determining the major and higher education institution for students.

This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



## 1. Introduction

Higher formal education is still mandatory for companies in the employee selection process. Not only that, formal education is also one part of a stratum of life in society. Therefore, choosing a good quality formal education is necessary to increase the opportunity to live a decent life. The choice of

higher formal education, including the major and higher education institution, is challenging for adolescent students. Although, according to [Wasilah et al. \(2023\)](#), errors in the selection of the major and higher education institution do not have a significant effect on learning values, but it can have an impact on the despair level in undergoing learning ([Arifin, Primayasa, and Baharsyah 2020](#)).

The research on the selection of formal education has been conducted in many countries such as Hongkong ([Wong et al. 2016](#)), Malaysia ([Migin et al. 2015](#); [Padlee, Kamaruddin, and Baharun 2010](#)), Serbia ([Mitić and Mojić 2020](#)), United States ([McCarthy, Sen, and Fox Garrity 2012](#)), Ghana ([Fosu and Poku 2014](#)), United Kingdom ([McManus, Haddock-Fraser, and Rands 2017](#)), Scotland ([Briggs 2006](#); [Briggs and Wilson 2007](#)), Germany ([Obermeit 2012](#)), and developed countries ([Vrontis, Thrassou, and Melanthiou 2007](#)). It can be concluded that the selection of higher education is a worldwide problem that most prospective students in many countries have experienced. However, each country may have different characteristics related to the criteria for determining determining majors and higher education institutions. Moreover, prospective students also have their preferences related to this problem ([McManus, Haddock-Fraser, and Rands 2017](#)).

A system is needed to decide on higher formal education selection to solve these problems. [Oktapiani et al. \(2020\)](#) using the Analytical hierarchical process (AHP) method. It's just that the calculations in the study are still conducted manually. AHP is the method that is widely used in multi-criteria decision-making ([Bhaskar and Khan 2022](#); [Gyani, Ahmed, and Haq 2022](#); [Hamidah et al. 2022](#); [Jatiningrum et al. 2019](#); [Mahammad and Islam 2021](#)). Related research about AHP in the higher education selection was also conducted by [Julizal et. al. \(2021\)](#). In this study, the determination of the major in vocational high school using the AHP method has been carried out using Criterium Decision Plus (CDP) 3.0 software. However, there needed to be tools to be used to determine majors and higher education institutions. Wrong in determining this matter has a burdensome impact on students. Therefore, the research contributes to developing a DSS to determine the major and higher education institution, considering several criteria based on AHP and the preferences of prospective students.

## 2. Method

The stages carried out in this study are identifying criteria and sub-criteria in determining a major and higher education institution based on the preferences of prospective students, building a decision-making system based on AHP, and DSS testing by users.

### 2.1. Identifying criteria and subcriteria in determining a major and higher education institution based on the preferences of prospective students

According to [Saaty \(1980\)](#), hierarchy is defined as a representation of a complex problem in a multilevel structure where the first level is the goal, followed by the factor level, criteria, sub-criteria and so on down to the last level of the alternative. The literature review was conducted to identify the criteria and sub-criteria for determining a major and higher education institution. There were 6 criteria obtained from literature review, tuition fee, scholarship, infrastructure (sub-criteria: library, classroom, laboratory, wifi), curriculum, quality (sub-criteria: accreditation, average study duration, achievement), and reputation ([Agrey and Lampadan 2014](#); [Harahap et al. 2021](#); [Wilkins, Shams, and Huisman 2013](#); [Wulandari et al. 2022](#)). These 6 criteria were validated by interviewing and distributing questionnaires to respondents. Respondents were also allowed to add criteria and sub-criteria not listed in the questionnaire.

The respondents were taken from students in a high school in Central Java, Indonesia. Determining the respondents is based on purposive sampling, students aged 16-18 years who will choose formal higher education. Meanwhile, the number of samples is calculated using the Slovin formula with a population of 345. Based on the calculation, as seen in equation (1), the total sample required is 186 students. Given that  $n$  is the sample size,  $N$  is the population size, and  $e$  is the error rate.

$$n = \frac{N}{1 + N e^2} = \frac{345}{1 + (345 \cdot 0.05^2)} = 186 \quad (1)$$

## 2.2. Building a decision-making system based on AHP

Hierarchy consists of goal, criteria and subcriteria, and alternatives as the basis for building a DSS. The goal of the DSS is to determine the major and higher education institution based on the preferences of prospective students. Criteria and subcriteria obtained from the previous stage are entered into the DSS. Meanwhile, alternatives to higher education institutions are free to be entered by DSS users. The algorithm used for this DSS is AHP, while the programming language was Borland Delphi. AHP is a method used to evaluate and make multi-criteria decisions (Saaty 1980; Yusof and Hasliah 2013). This evaluates several alternatives based on different criteria and sub-criteria and then assigns a relative score to each alternative. The principles that must be understood in solving problems with AHP are:

- a. Decomposition, is conducted by breaking the whole problem into its elements.
- b. Comparative judgements, are used to judge the relative importance of two elements at a certain level in relation to the level above it. The results of the assessment are presented in pairwise comparison matrix.
- c. Synthesis of Priority. Eigen vector is calculated on each pairwise comparison matrix to get local priority. Then, synthesis between local priority must be conducted to get global priority.
- d. Logical Consistency. Consistency is measured based on the value of the consistency ratio as shown in equation (2). Given that CI is Consistency Index, CR is Consistency Ratio, and RI is Random Index.

$$CR = \frac{CI}{RI} \quad (2)$$

DSS was also developed by referring to:

1. Context diagram, was used to show a single high level process that describes process and scope in a system
2. Data flow diagram (DFD), was used to describe the data flow of a process to ease for developers to build an application. DFD provides a visual picture of who will be involved in the process from start to finish.
3. Entity relationship diagram (ERD), was used to describe the relationship between entities (objects) in a database.

## 2.3. DSS testing by users

DSS testing aims to ensure that the built DSS is following predetermined requirements. The DSS tests used include:

1. Black box test, was carried out to find out the results of the DSS output and check the application's functionality.
2. Beta test, was useful for measuring the quality of the user experience when interacting with DSS to determine a major and higher education institution.
3. Compatibility test with manual calculation, aimed to determine the suitability between DSS calculation results and manual calculations

### 3. Results and Discussion

#### 3.1. Identification of criteria and subcriteria in determining a major and higher education institution based on the preferences of prospective students

Questionnaires to identify criteria and subcriteria were distributed to 186 respondents. Respondents were asked to assess the rate of importance from criteria and subcriteria obtained from literature review. The importance score that must be checked by the respondent is from 1-4 which indicates very unimportant to very important. Moreover, respondents were allowed to add criteria and sub-criteria, other than those derived from the literature review. The results showed that all criteria and sub-criteria from literature review have an average score above 3, except a sub-criteria wifi. This means that all criteria and sub-criteria with a score above 3 were considered important in determining a major and higher education institution. Meanwhile, sub-criteria wifi was considered to be removed because respondents thought this was not important.

Furthermore, there were additional criteria and sub-criteria based on the results of the questionnaires distributed to respondents. They were criteria for international collaboration and sub-criteria for teaching staff and transportation, which are included in the infrastructure criteria. Finally, the criteria and sub-criteria used were:

1. Tuition fee, is total amount of money paid by individuals during their study in higher education
2. Scholarship, is a grant given to students in the higher education institution
3. Infrastructure, is all the facilities provided to support the implementation of various activities in higher education institutions. This criterion has the following sub-criteria:
  - a. Library, is facilities owned by the campus to provide library materials and information in various forms, such as books, journals, and reports
  - b. Classroom, is the place where the teaching and learning process takes place
  - c. Laboratory, is facilities used by students to practice what they have learned during lectures
  - d. Transportation, is related to the ease of accessibility of transportation around higher education institutions
  - e. Teaching staff, is professional educators and scientists with the main task of transforming, developing and disseminating science, technology and art through education, research and community service.
4. Curriculum, is a system of plans and arrangements regarding learning materials that can be guided in teaching and learning activities.
5. Quality, is the characteristic of a higher education institution that supports its ability to satisfy student needs. This criterion has the following sub-criteria:
  - a. Accreditation, is a value indicating government recognition of a higher education institution
  - b. Study period, is the average length of time that students need to graduate from higher education
  - c. Achievement, is a tangible manifestation of the quality and quantity obtained by the higher education institution for the efforts made
6. Reputation, is the fame level of majors and higher education institutions among students.
7. International collaboration, is collaboration carried out by two or more higher education institutions from different countries with the aim of developing institutional quality.

### 3.2. Building a decision-making system based on AHP

The DSS was developed based on the following stages:

#### 1. Context diagram

The design of the system developed for decision making in determining major and higher education institution was based on the context diagram. Fig. 1. shows context diagram used for the DSS.

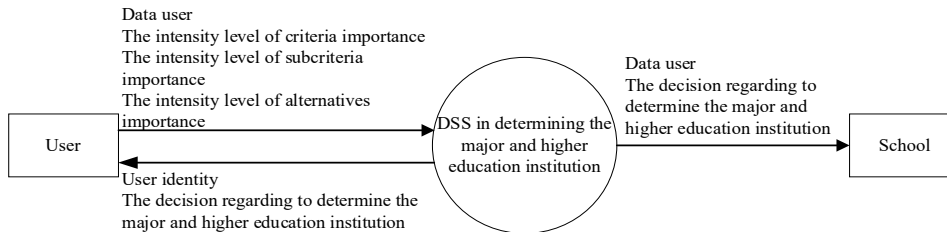


Fig. 1. Context diagram of the DSS

According to Fig. 1, user and school were external entities or parties outside the system. User or final grade students provided input to the system, such as data user, the intensity level of criteria importance, subcriteria importance, and alternatives importance. The process conducted in the system was data analysis toward multi-criteria decision problem using AHP algorithm to determine the major and higher education institution. User and school received output from the system, such as user identity and the decision to determine the major and higher education institution.

#### 2. DFD

DFD provided information about the input and output of each entity, and the process itself (Suhirman et al. 2021). Fig 2. shows DFD used for the DSS. In this stage, the user needed to input user ID, the intensity level of criteria importance and the intensity level of subcriteria importance.

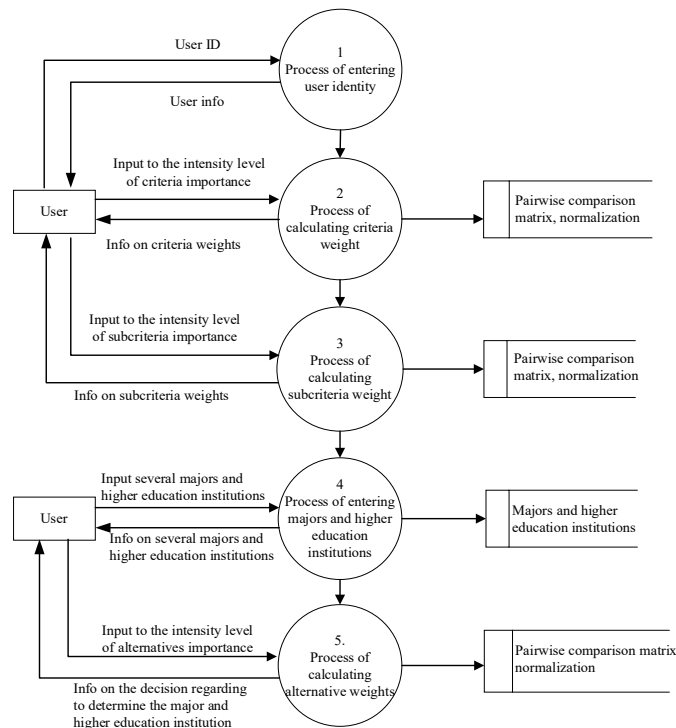


Fig. 2. DFD of the DSS

The data of intensity level of criteria importance and subcriteria importance were then calculated in sytem using AHP algorithm. After that, the system stored the pairwise comparison matrix and normalization result. The user got information related to user info and about the criteria and sub-criteria weights in determining the major and higher education institution. Then, the user entered several couples of majors and higher education institutions of interest as the alternatives. In addition, the user also needed to input the intensity level of alternative importance based on each criterion and subcriteria. The system analyzed data using AHP, so the user reached on the decision regarding to determine the major and higher education institution.

### 3. ERD

ERD used to design the DSS is shown in Fig. 3. There were 4 entities used: user, criteria, sub-criteria, and alternatives. There was a relationship among these entities (Suhirman et al. 2021). A user has to input the intensity level for many criteria, many sub-criteria, and many alternatives. Each entity also has some attributes, as shown in Fig. 3. Entitiy of the user has 2 attributes, criteria has 2 attributes, sub-criteria has 2 attributes, and alternatives has 3 attributes.

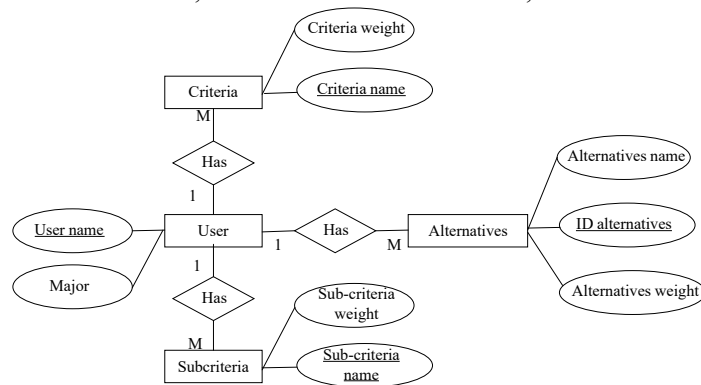


Fig. 3. ERD of the DSS

### 4. According to the design of application referred to as Context Diagram, DFD, and ERD, DSS was developed as follows:

#### a. Homepage

The initial display appeared when the DSS was run was the interface for filling in the user's identity, such as name and major in high school. The homepage display can be seen in Fig. 4.



Fig. 4. User interface homepage

b. Instructions for use

The display provided on this menu was the instructions for using the DSS in determining the major and higher education institution. In addition, there were examples of weighting for criteria and sub-criteria. This display is showed in Fig. 5.

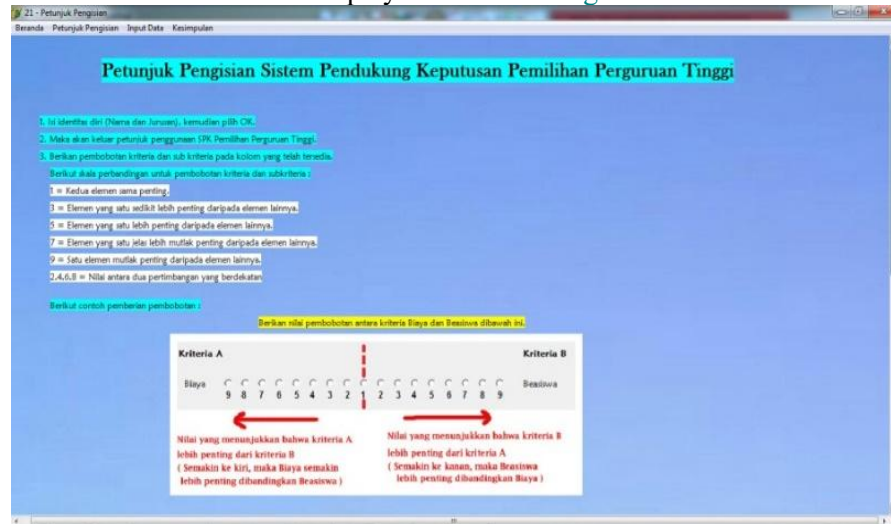


Fig. 5. User interface of instructions for use

c. Menu for data input

In this interface, the user must input the level of importance based on pairwise comparison questions. These questions included pairwise comparisons between criteria, sub-criteria, and alternatives based on criteria and sub-criteria. After that, the system will transform the input into pairwise comparison matrices. These matrices will be analyzed using AHP. The output was the weight of criteria, subcriteria, and alternatives according to criteria and subcriteria. Fig. 6 shows the display of menu for data input.

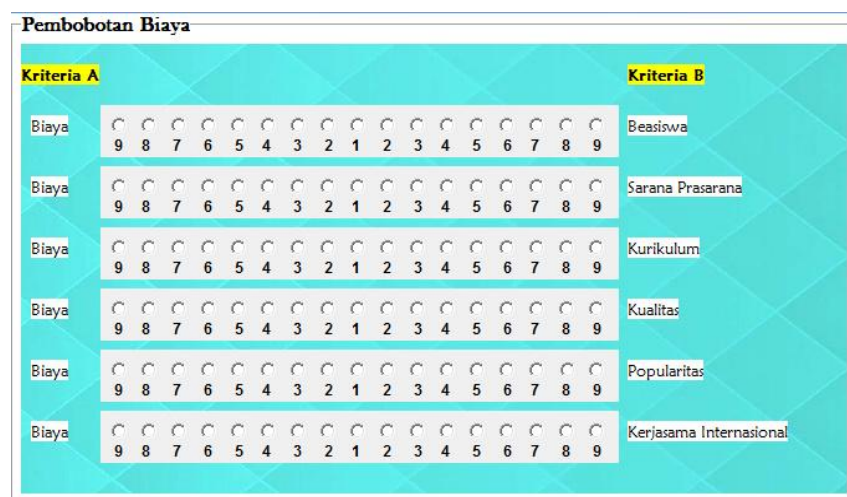


Fig. 6. User interface of menu for data input

d. User interface conclusion

The display appeared on this menu was the result of AHP calculations based on input from menu data for input. The data displayed were name and major in school. In addition, output

from AHP analysis was the order list of the major and higher education institution to be prioritized. Interface for conclusion is showed in Fig. 7.



Fig. 7. User interface conclusion

### 3.3. DSS testing by users

DSS testing included blackbox test, beta test and manual calculations using Ms Excel.

#### 1. Blackbox test

The Blackbox test focused on the DSS's functional specifications (Aliero et al. 2020). This test was conducted to see the response of the DSS when users carried out the data input process. Table 1, 2, and 3 show the result of blackbox test for input user identity data, input criteria and sub-criteria, and output AHP analysis.

Table 1. The Result of Blackbox Test

No	Testing Scenarios	Test Cases	Expected Results	Test Results
1	No data is entered	Homepage	The system will refuse to continue with the next step, and will display an error message.	Appropriate
2	The data entered is incomplete		The system will refuse to continue with the next step, and will display an error message.	Appropriate
3	Input data according to fields		The system will proceed to the next step	Appropriate
4	No data is entered	Menu for data input,	The system will refuse to continue with the next step, and will display an error message.	Appropriate
5	The data entered is incomplete	including criteria, sub-criteria, and alternatives	The system will refuse to continue with the next step, and will display an error message.	Appropriate
6	Input data according to fields		The system will proceed to the next step	Appropriate
7	Click calculate after input the level of importance based on pairwise comparison questions	Conclusion	The order list of the major and higher education institution to be prioritized	Appropriate



## 2. Beta test

This test began by giving an explanation in advance regarding the DSS to 5 respondents, then respondents were asked to use the DSS directly. Afterwards, respondents were asked to fill out a user testing questionnaire consisting of 20 questions. This questionnaire is useful for knowing the user's understanding of using the DSS. The questions were related to aspect of correctness, reliability, integrity, and usability (Aliero et al. 2020).

**Table 2.** The Result of Beta Test

No	Aspect	Average score	Qualitative Criteria
1	Correctness	20.4	Very good
2	Reliability	16.8	Very good
3	Integrity	3.4	Good
4	Usability	25.5	Very good

Score calculation from the questionnaire was carried out to determine the qualitative criteria of each aspect. Table 2 shows the result of Beta test. The average score of each aspect was included in the good and very good categories. Therefore, it can be concluded that the developed DSS can be well understood and used by final grade students who will continue their study.

## 3. Compatibility test with manual calculations

An example of case was used to compare the results of calculations using the DSS and manual calculations using Ms. Excel based on AHP. Alternatives of major and higher education institution entered were consist of Hukum-UNDIP, Sastra Indonesia-UNS, and Hukum-UNS. Calculations was conducted to determine the weight of criteria and sub-criteria, and global weight of alternatives. CR was also calculated for each of step to ensure the level of consistency of decision makers when filling in the comparison values between a pair of objects (Shen et al. 2019). Table 3 and Table 4 show the comparison between criteria weight and sub-criteria weight using the DSS and manual calculations. The results of the criteria weight and sub-criteria weight obtained from both the DSS and manual calculations were the same. Likewise, both CR values were the same. They were 0.092 for criteria weight and 0.09 for sub-criteria weight.

**Table 3.** The Comparison of Criteria Weight

Criteria	The DSS	Manual Calculations
Tuition fee	0.212	0.212
Scholarship	0.342	0.342
Infrastructure	0.131	0.131
Curriculum	0.079	0.079
Quality	0.129	0.129
Reputation	0.042	0.042
International collaboration	0.065	0.065

**Table 4.** The Comparison of Sub-criteria Weight

Sub-criteria	The DSS	Manual Calculations
Library	0.137	0.137
Classroom	0.166	0.166
Laboratory	0.505	0.505
Transportation	0.035	0.035
Teaching Staf	0.157	0.157

Meanwhile, output the DSS for global weight of alternatives were compared to the result of manual calculations, as seen in Table 5. The results showed that there was no difference between

output of the DSS and manual calculations. This proved that AHP as a method for solving multi-criteria decision-making problems can be implemented properly in DSS. Therefore, it can be concluded that the DSS can be used as a tool to determine the major and higher education institution based on several criteria and sub-criteria.

**Table 5.** The Comparison of Global Weight for Alternatives

Alternatives	The DSS	Manual Calculations
Hukum-UNDIP	0.315	0.315
Sastra Indonesia-UNS	0.149	0.149
Hukum-UNS	0.537	0.537

#### 4. Conclusion

The DSS has been developed to determine a major and higher education institution. The DSS was built based on AHP to solve multi-criteria decision problems. Criteria and sub-criteria used were tuition fee, scholarship, infrastructure (sub-criteria: library, classroom, laboratory, transportation, teaching staff), curriculum, quality (sub-criteria: accreditation, study period, achievement), reputation, and international collaboration. The DSS was developed based on design referred to as the context diagram, DFD, and ERD. The DSS was also tested through beta tests, black box text, and compatibility tests with manual calculations. The result showed that DSS can be well implemented as a tool to determine the major and higher education institution based on several criteria and sub-criteria

**Author Contribution:** All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.

**Funding:** This research received no external funding

**Conflicts of Interest:** Declare conflicts of interest or state, “The authors declare no conflict of interest.”

#### References

- Agrey, Loren, and Naltan Lampadan. 2014. “Determinant Factors Contributing to Student Choice in Selecting a University.” *Journal of Education and Human Development* 3(2): 391–404.
- Aliero, Muhammad Saidu, Imran Ghani, Kashif Naseer Qureshi, and Mohd Fo’ad Rohani. 2020. “An Algorithm for Detecting SQL Injection Vulnerability Using Black-Box Testing.” *Journal of Ambient Intelligence and Humanized Computing* 11(1): 249–66. <https://doi.org/10.1007/s12652-019-01235-z>
- Arifin, Imamul, Wahyu Primayasa, and Muhammad Yusuf Baharsyah. 2020. “Pengaruh Salah Pilih Jurusan Terhadap Rasa Putus Asa Mahasiswa Teknik Informatika.” *Nathiqiyah Jurnal Psikologi Islam* 3(1): 22–26. <https://doi.org/10.46781/nathiqiyah.v3i1.76>
- Bhaskar, A S, and A Khan. 2022. “Comparative Analysis of Hybrid MCDM Methods in Material Selection for Dental Applications.” *Expert Systems with Applications* 209: 118268. <https://doi.org/10.1016/j.eswa.2022.118268>
- Briggs, S. 2006. “An Exploratory Study of the Factors Influencing Undergraduate Student Choice: The Case of Higher Education in Scotland.” *Studies in Higher Education* 31(6): 705–722. <https://doi.org/10.1080/03075070601004333>
- Briggs, S, and A Wilson. 2007. “Which University? A Study of the Influence of Cost and Information Factors on Scottish Undergraduate Choice.” *Journal of Higher Education Policy and Management* 29(1): 57–72. <https://doi.org/10.1080/13600800601175789>

- Fosu, F F, and K Poku. 2014. "Exploring the Factors That Influence Students' Choice of Higher Education in Ghana." *European Journal of Business and Management* 6(28): 209–220.
- Gyani, J, A Ahmed, and M A Haq. 2022. "MCDM and Various Prioritization Methods in AHP for CSS: A Comprehensive Review." *IEEE Access* 10: 33492–33511. <https://doi.org/10.1109/ACCESS.2022.3161742>
- Hamidah, M et al. 2022. "Development of a Protocol for Malaysian Important Plant Areas Criterion Weights Using Multi-Criteria Decision Making-Analytical Hierarchy Process (MCDM-AHP)." *Global Ecology and Conservation* 34: 2033. <https://doi.org/10.1016/j.gecco.2022.e02033>
- Harahap, Dedy Ansari, Dita Amanah, Muji Gunarto, and Purwanto Purwanto. 2021. "The Decision of Choosing a University: The Impact of Education Costs." *JIM UPB (Jurnal Ilmiah Manajemen Universitas Putera Batam)* 9(2): 123–27. <https://doi.org/10.33884/jimupb.v9i2.3712>
- Jatiningrum, Wandhansari Sekar et al. 2019. "Consumer Preference for Mocaf Packaging Using Analytical Hierarchy Process (AHP)." *Jurnal Ilmiah Teknik Industri* 18(2): 153–60. <https://doi.org/10.23917/jiti.v18i2.8473>
- Julizal, Lukman, and Imam Sunoto. 2021. "Sistem Pendukung Keputusan Pemilihan Jurusan Smk Adi Luhur." In *Prosiding Seminar Nasional Sais*, , 366–75.
- Mahammad, S, and A Islam. 2021. "Evaluating the Groundwater Quality of Damodar Fan Delta (India) Using Fuzzy-AHP MCDM Technique." *Applied Water Science* 11: 1–17. <https://doi.org/10.1007/s13201-021-01408-2>
- McCarthy, E E, A K Sen, and B Fox Garrity. 2012. "Factors That Influence Canadian Students' Choice of Higher Education Institutions in the United States." *Business Education & Accreditation* 4(2): 85–95. <https://doi.org/10.1080/1360080X.2017.1330806>
- McManus, R, J Haddock-Fraser, and P Rands. 2017. "A Methodology to Understand Student Choice of Higher Education Institutions: The Case of the United Kingdom." *Journal of Higher Education Policy and Management* 39(4): 390–405.
- Migin, M W, M Falahat, M S A Yajid, and A Khatibi. 2015. "Impacts of Institutional Characteristics on International Students' Choice of Private Higher Education Institutions in Malaysia." *Higher Education Studies* 5(1): 31–42. <https://doi.org/10.5539/hes.v5n1p31>
- Mitić, S, and D Mojić. 2020. "Student Choice of Higher Education Institutions in a Post-Transitional Country: Evidence from Serbia." *Economic Research-Ekonomska Istraživanja* 33(1): 3509–3527. <https://doi.org/10.1080/1331677X.2020.1774794>
- Obermeit, K. 2012. "Students' Choice of Universities in Germany: Structure, Factors and Information Sources Used." *Journal of Marketing for Higher Education* 22(2): 206–230. <https://doi.org/10.1080/08841241.2012.737870>
- Oktapiani, Renny et al. 2020. "Penerapan Metode Analytical Hierarchy Process (AHP) Untuk Pemilihan Metode Pembelajaran." *JSI: Jurnal Sistem Informasi (E-Journal)* 12(1): 106–13. <https://doi.org/10.36706/jsi.v12i1.9537>
- Padlee, S F, A R Kamaruddin, and R Baharun. 2010. "International Students' Choice Behavior for Higher Education at Malaysian Private Universities." *International Journal of Marketing Studies* 2(2): 202. <https://doi.org/10.5539/ijms.v2n2p202>
- Saaty, Thomas L. 1980. *The Analytic Hierarchy Process*. McGraw-Hill. <https://doi.org/10.21236/ADA214804>
- Shen, Liqiong et al. 2019. "Based on Delphi Method and Analytic Hierarchy Process to Construct the Evaluation Index System of Nursing Simulation Teaching Quality." *Nurse Education Today* 79: 67–73. <https://doi.org/10.1016/j.nedt.2018.09.021>

- 
- Suhirman, Suhirman, Ahmad Tri Hidayat, Wahyu Adjie Saputra, and Shoffan Saifullah. 2021. "Website-Based E-Pharmacy Application Development to Improve Sales Services Using Waterfall Method." *International Journal of Advances in Data and Information Systems* 2(2): 114–29. <https://doi.org/10.25008/ijadis.v2i2.1226>
- Vrontis, D, A Thrassou, and Y Melanthiou. 2007. "A Contemporary Higher Education Student-Choice Model for Developed Countries." *Journal of Business Research* 60(9): 979–989. <https://doi.org/10.1016/j.jbusres.2007.01.023>
- Wasilah et al. 2023. "Pengaruh Salah Pilih Jurusan Terhadap Nilai Akademik Mahasiswa Program Studi BKI UIN Khas Jember." *Jurnal Ilmu Sosial, Humaniora, dan Seni (JISHS)* 1(3): 615–19.
- Wilkins, Stephen, Farshid Shams, and Jeroen Huisman. 2013. "The Decision-Making and Changing Behavioural Dynamics of Potential Higher Education Students: The Impacts of Increasing Tuition Fees in England." *Educational Studies* 39(2): 125–41. <https://doi.org/10.1080/03055698.2012.681360>
- Wong, P, P M Ng, C K Mak, and J K Chan. 2016. "Students' Choice of Sub-Degree Programmes in Self-Financing Higher Education Institutions in Hong Kong." *Higher Education* 71: 455–472. <https://doi.org/10.1007/s10734-015-9915-5>
- Wulandari, Rosanna et al. 2022. "The Effect of Study Program Accreditation on Decision-Making of New Students Through Promotion in Higher Education in Mojokerto." *AL-ISHLAH: Jurnal Pendidikan* 14(4): 7217–28. <https://doi.org/10.35445/alishlah.v14i4.2102>
- Yusof, Nur Ashikin Mohamed, and Siti Hasliah. 2013. "Analytical Hierarchy Process in Multiple Decisions Making for Higher Education in Malaysia." *Procedia - Social and Behavioral Sciences* 81: 389–94. <http://dx.doi.org/10.1016/j.sbspro.2013.06.448>  
<https://doi.org/10.1016/j.sbspro.2013.06.448>