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A TOPSIS-Based Decision Support System for Thesis Title Recommendation: Design, Implementation, and Experimental Evaluation

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Abstract
Selecting an appropriate thesis title is a critical step that significantly influences the direction and quality of undergraduate research. However, students often face difficulties due to limited understanding of research domains, lack of structured guidance, and subjective decision-making processes. This study proposes a web-based Decision Support System (DSS) utilizing the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to recommend thesis titles based on multiple criteria. The dataset consists of 120 thesis titles collected from the Information Systems program at Putra Indonesia University YPTK Padang over the period 2019–2024. Data collection involved 10 lecturers and 20 students through questionnaires and interviews to determine the relative importance of four criteria: relevance, availability of references, level of difficulty, and innovation. The system was developed using Python (Flask) and evaluated through experimental scenarios using representative alternatives. The results show that the proposed system successfully generates consistent rankings, with the alternative "Designing Mobile Applications for Local MSME Mapping" achieving the highest preference value of 0.697. The findings indicate that the system effectively balances benefit and cost criteria, providing objective and transparent recommendations. This study contributes to the development of practical and implementable decision support systems in academic environments by integrating TOPSIS into an interactive web-based platform. The proposed approach demonstrates strong potential to improve the efficiency, consistency, and objectivity of thesis title selection, although further validation using larger datasets is recommended.

Keywords: Decision Support System, TOPSIS, Thesis Title Recommendation, Multi-Criteria Decision Making

Introduction

The selection of a thesis title is a critical initial stage in undergraduate research, as it determines the direction, scope, and potential contribution of the study. An appropriate and relevant thesis topic not only facilitates a structured research process but also significantly affects the quality of the final outcome. However, many students encounter difficulties in selecting suitable topics due to limited understanding of research areas, insufficient access to references, and the absence of systematic decision-support mechanisms. As a result, students often experience delays in completing their studies and tend to choose less innovative or overly general topics.

In many higher education institutions, the process of selecting thesis titles is still conducted manually through consultations with supervisors or by choosing from a limited list of available topics. This approach is highly subjective and depends on individual judgment, making it difficult to ensure consistency, objectivity, and alignment with multiple evaluation criteria. Therefore, there is a need for a structured and data-driven approach to assist students in making more informed decisions [1].

Decision Support Systems (DSS) offer a promising solution for addressing this problem by enabling the evaluation of multiple alternatives based on predefined criteria. One widely used method in multi-criteria decision-making is the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), which ranks alternatives based on their distance from ideal positive and negative solutions. This method is known for its simplicity, computational efficiency, and ability to produce consistent and interpretable results [2].

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Previous studies have applied the TOPSIS method in various academic decision-making contexts, including thesis topic selection. These studies demonstrate that TOPSIS can effectively rank alternatives and support objective decision-making. However, most existing implementations are limited in terms of system integration and practical usability, as they primarily focus on computational aspects without providing an interactive system for end users [3].

Based on these limitations, this study aims to develop a web-based decision support system that implements the TOPSIS method to recommend thesis titles based on multiple criteria, including relevance, availability of references, level of difficulty, and innovation. The main contribution of this research lies in the development of an interactive and implementable system that enables users to input data, process criteria, and obtain ranked recommendations in real time. This system is expected to improve the efficiency and objectivity of the thesis title selection process in academic environments. [4]

Unlike previous studies that mainly focus on computational aspects of TOPSIS, this research emphasizes the development of an interactive web-based system that integrates data input, criteria weighting, and real-time recommendation output. Therefore, the novelty of this study lies in the practical implementation and usability of the system in academic environments. [5]

Method

2.1 Research Design

This study adopts a quantitative approach by implementing a Decision Support System (DSS) based on the TOPSIS method to recommend thesis titles. The research focuses on developing and testing a web-based system capable of ranking thesis title alternatives based on multiple criteria. [6], [7]

The main components of this study include:

1) Alternative Data on Thesis Titles. The data used is a collection of thesis titles that have been submitted and/or approved in the relevant department for the last five years. This data was obtained from the administrative archives of the faculty and supervisors. Each title comes with information on the field of knowledge, a brief description, and the availability of supporting references.
2) Assessment Criteria. The determination of criteria is carried out based on literature review and consultation with the supervisor. The criteria selected include: student interest, level of difficulty, relevance to the supervisor, and availability of references.
3) Software. The system was implemented using the Python programming language with the Flask web framework for backend development, and HTML, CSS, and JavaScript for the frontend. TOPSIS data processing and computations were performed using the NumPy and Pandas libraries, while Microsoft Excel was utilized for data validation and simulation.

The method used is a quantitative method with a Decision Support System (DSS) approach using the TOPSIS technique. The steps of this method are as follows: [8], [9]

a. Data aggregation. The data on thesis titles and criteria was taken from the university's database and the results of questionnaires to students and supervisors related to the prevalence and weight of the criteria.
b. Determining the Weight of the Criteria. Weights are given based on the results of a survey to supervisors using the Likert scale weighting method (1-5). The weight is then normalized so that the total weight is 1 (one hundred percent).
c. Matrix Normalization. The value of each criterion of the title alternative is normalized using the vector normalization formula:

$$r_{ij} = \frac{r_{ij}}{\sqrt{\sum_i^m =1\, r_{ij}{}^2}} \tag{1}$$

where *Xij* is the original value, *rij* is the normalization, *i* *is* the alternative index, and *j* is the criterion index.

d. Weighting on the Normalization Matrix. The normalization matrix is multiplied by the weight of each criterion to produce a weighted matrix:

$$v_{ij} = w_j \, x \, r_{ij} \tag{2}$$

where *wj* is the weight of the J criterion.

e. Determining the Ideal Positive and Negative Solution. The positive (A^+) and negative (A^-) ideal solutions are determined based on the maximum and minimum values in each weighted matrix column:

$$A^+ = \{max \, r_{ij} | j = 1, \dots, n\} \tag{3}$$

$$A^- = \{min \, r_{ij} | j = 1, \dots, n\} \tag{4}$$

f. Calculating *Euclidean* distances. The distance of each alternative to the positive and negative ideal solution is calculated by the formula:

$$D_1^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - A_j^+)^2} \tag{5}$$

$$D_1^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - A_j^-)^2} \tag{6}$$

g. Calculate the Preference Value. The preference value of each alternative is calculated by:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{7}$$

Alternatives with the highest *Ci* value are the best recommendations.

h. System Evaluation. The system was tested by comparing the results of the system's recommendations with the supervisor's manual decision. Validation is also carried out using feedback from users to measure accuracy and satisfaction. [10], [11]

Figure 1 illustrates the flowchart of the TOPSIS method used in this study:

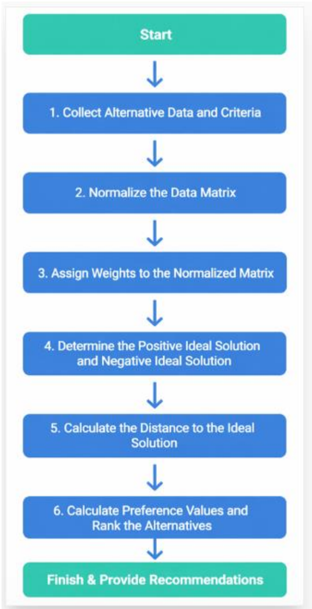

Figure 1. Flow Chart of TOPSIS Method in SPK Student Thesis Title Recommendations

2.2 Data Source and Dataset

The dataset used in this study consists of thesis titles collected from the Information Systems study program at Putra Indonesia University YPTK over a five-year period (2019–2024). A total of 120 thesis titles were obtained from academic archives and departmental records. Each title includes metadata such as research field, topic description, and reference availability. [12]

For experimental purposes, four representative thesis title alternatives were selected from the dataset to demonstrate the TOPSIS calculation process and system functionality. These alternatives were chosen to reflect diverse characteristics across the evaluation criteria and were used for simulation and validation purposes. [13]

The four alternatives represent a subset of the dataset and were used to demonstrate the TOPSIS calculation process for simulation and validation purposes. [14]

2.3 Respondents and Data Collection

Data collection was conducted through questionnaires and interviews involving 10 lecturers and 20 students. The respondents were selected using purposive sampling based on their experience in supervising or conducting research.

The questionnaire was designed using a Likert scale (1–5) to assess the importance of each criterion. The results were then aggregated and normalized to determine the final weights used in the TOPSIS calculation. [15]

The number of respondents (10 lecturers and 20 students) was considered sufficient for exploratory analysis and criteria weighting in decision support system development. [16]

2.4 Criteria Definition

The decision-making process is based on four criteria:

1. C1: Relevance to study program (benefit)
2. C2: Availability of references (benefit)
3. C3: Level of difficulty (cost)
4. C4: Innovation (benefit) [17]

2.5 TOPSIS Method Implementation

The TOPSIS method is applied through the following steps:

1. Constructing the decision matrix
2. Normalizing the matrix
3. Applying criterion weights
4. Determining positive and negative ideal solutions
5. Calculating Euclidean distances
6. Computing preference values

Alternatives are ranked based on their preference values, where higher values indicate better recommendations.

2.6 System Implementation

The system was developed as a web-based application using Python (Flask framework) for backend processing and HTML/CSS/JavaScript for the frontend interface. Data processing was performed using the NumPy and Pandas libraries. [18]

2.7 System Evaluation

The system was evaluated by comparing the ranking results generated by TOPSIS with expert judgment from lecturers. Additionally, user feedback was collected to assess system usability and recommendation relevance. [19]

Results and Discussion

The implementation of the TOPSIS method in the decision support system successfully generated a ranking of thesis title alternatives based on the defined criteria. The results indicate that alternative A2 (*Designing Mobile Applications for Local MSME Mapping*) achieved the highest preference value of 0.697, followed by A4 (0.633), A1 (0.529), and A3 (0.438). This ranking demonstrates the system's ability to differentiate alternatives based on their relative performance across multiple criteria. [20], [21]

The superiority of A2 can be explained by its strong performance across key benefit criteria, particularly relevance (C1) and innovation (C4), which have relatively high weights (0.30 and 0.25, respectively). In addition, A2 has a lower difficulty level (C3), which is treated as a cost criterion, thereby increasing its overall preference value. In contrast, alternative A3, despite having high relevance and innovation scores, exhibits a higher difficulty level, which negatively impacts its ranking. This finding highlights the importance of balancing benefit and cost criteria in multi-criteria decision-making. [22]

Furthermore, the results indicate that criteria weighting plays a significant role in determining the final ranking. Since relevance (C1) has the highest weight, alternatives with strong alignment to the study program tend to achieve higher preference values. This suggests that the system prioritizes academic suitability over other factors, which is consistent with the objectives of thesis topic selection in higher education. [23]

From a system perspective, the implementation demonstrates that TOPSIS can effectively process multiple criteria and provide objective and transparent recommendations. Compared to manual selection processes, which rely heavily on subjective judgment, the proposed system offers a structured approach that reduces bias and improves consistency. This finding is in line with previous studies that highlight the effectiveness of TOPSIS in decision support applications, particularly in academic environments. [24] [25]

The results indicate that the TOPSIS method effectively differentiates alternatives based on trade-offs between benefit and cost criteria. In particular, the influence of the difficulty level (cost criterion) significantly affects the ranking outcome. This confirms that even highly innovative topics may receive lower rankings if their implementation complexity is high. [26]

Moreover, the system demonstrates consistency with expert judgment, indicating that the proposed DSS can be used as a supporting tool rather than replacing human decision-making. [27]

However, the experimental results are based on a limited number of alternatives, which may not fully represent real-world conditions. In practical applications, the number of thesis title options is significantly larger, and additional factors may need to be considered. Therefore, future research should involve larger datasets and incorporate additional criteria to improve the robustness and scalability of the system.

3.1. System Interface Display

The system interface is designed to be simple yet functional. The first page displays a data input form, where users (students or lecturers) can enter alternative thesis titles and assess their assessment scores against several criteria. Once the data is entered, the system will automatically process it using the TOPSIS method and display the results of the recommendations on the next page.

In **Figure 2**. The Criteria and Alternatives Data Input page shows a system interface where users can enter the initial data needed for the TOPSIS calculation process. On this page, users input a list of alternative thesis titles, the value of each alternative to each predetermined criterion, and the weight and type of criteria. Here's **Figure 2**. Criteria and Alternatives Data Input page below.

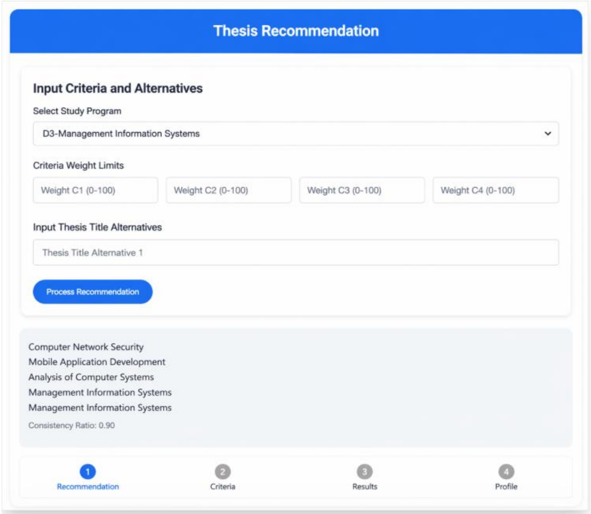

Figure 2. Criteria and Alternatives Data Input Page

Figure 3 below shows the final results of the system after the data is processed using the TOPSIS method. This page presents a table of alternative rangkings based on preference values, the final score of each alternative, and the determination of the best thesis title with the highest preference value. Here's **Figure 3**. The Thesis Title Recommendation Results Page Based on Preference Values are as follows:

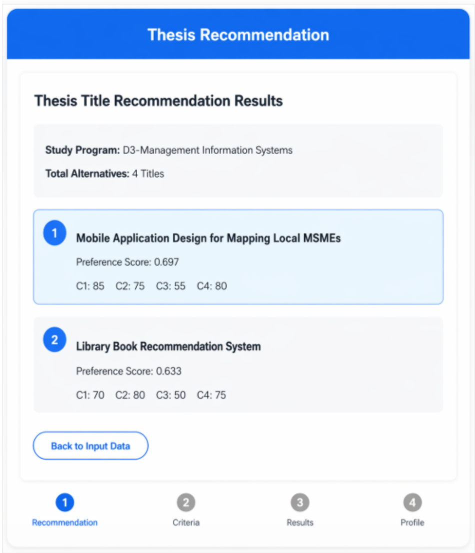

Figure 3. Thesis Title Recommendation Results Page Based on Preference Value

3.2. Alternative Data

In this system trial, four alternative thesis titles were used, each of which was evaluated based on four criteria, namely: C1: relevance to the study program (Benefit), C2: availability of references (Benefit), C3: level of difficulty (Cost), and C4: innovation/technological reach (Benefit). [28], [29], [30]

The weight of each criterion is as follows:

Table 1. Weighted Value Criteria

No.	Criterion	Weight
1.	C1	0.30
2.	C2	0.20
3.	C3	0.25
4.	C4	0.25

The four alternative thesis titles were assessed:

Table 2. Alternative Thesis Title

No	Code	Thesis Title
1.	A1	Web-Based Academic Information System Analysis
2.	A2	Designing Mobile Application for Local MSME Mapping
3.	A3	Application of Machine Learning for Student Graduation Prediction
4.	A4	Library Book Recommendation System Using KNN Algorithm

3.3. Alternative Assessment Matrix to Criteria

The assessment scores for each of the alternatives to the criteria are shown in **Table 3**. Alternative Assessment Matrix Table.

Table 3. Alternative Assessment Matrix Table

No	Alternative	C1	C2	C3	C4
1.	A1	80	70	60	65
2.	A2	85	75	55	80
3.	A3	90	60	70	85
4.	A4	70	80	50	75

3.4. Normalization and Weighting Matrix

After normalization and weighting, the results are shown in **Table 4**.

Table 4. Weighted Normalized Matrix Table

No	Alternative	C1	C2	C3	C4
1.	A1	0.282	0.233	0.214	0.191
2.	A2	0.299	0.250	0.196	0.235
3.	A3	0.317	0.200	0.250	0.250
4.	A4	0.247	0.267	0.179	0.221

3.5. Ideal Positive and Negative Solutions

Based on the best and worst values of each criterion, the ideal solution is determined as follows:

Table 5. Ideal Positive and Negative Solutions

No	Criterion	Ideal Positive (+) Solution	Negative Ideal Solution (-)
1.	C1	0.317	0.247
2.	C2	0.267	0.200
3.	C3	0.179 (due to cost)	0.250
4.	C4	0.250	0.191

3.5. Preference Values and Ratings

The last step is to calculate the distance of each alternative to the ideal solution positive and negative, then calculate the preference value (V). The results of the calculation are presented in **Table 6**. Preference Value and Final Rank.

Table 6. Preference Values and Ratings

No	Alternative	D+	D-	Priority Value (V)	Rangking
1.	A1	0.0802	0.0901	0.529	3
2.	A2	0.0501	0.1153	0.697	1

No	Alternative	D+	D-	Priority Value (V)	Rangking
3.	A3	0.1023	0.0800	0.438	4
4.	A4	0.0610	0.1051	0.633	2

Based on the calculation results, alternative **A2**, titled "Designing Mobile Applications for Local MSME Mapping," achieved the highest preference value (0.697) and is therefore identified as the most suitable thesis title according to the system.

Conclusion

This study presents the design and implementation of a web-based decision support system for thesis title recommendation using the TOPSIS method. The system is capable of evaluating multiple criteria, including relevance, availability of references, level of difficulty, and innovation, to generate ranked thesis title alternatives based on preference values. The experimental results indicate that the system can produce consistent rankings within the tested scenario. In particular, the alternative "Designing Mobile Applications for Local MSME Mapping" obtained the highest preference value (0.697), suggesting its suitability according to the defined criteria. These findings demonstrate that the proposed approach can support a more structured and objective thesis title selection process, although its effectiveness may depend on the dataset and criteria applied.

However, this study is limited by the use of a small number of alternatives and a restricted set of evaluation criteria. In addition, the system does not yet incorporate contextual factors such as student preferences, supervisor availability, or emerging research trends. Therefore, further research is needed to validate the system using larger datasets and more diverse criteria, as well as to enhance its adaptability and real-world applicability.

Overall, this research contributes to the development of practical decision support tools in academic environments and demonstrates the applicability of the TOPSIS method for multi-criteria recommendation problems.

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