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Employing Fuzzy AHP in Modeling a Decision Support System for Determining Scholarship Recipients within the University Context.

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ABSTRACT

In the realm of university scholarship programs, the process of selecting deserving recipients presents a complex decision-making challenge. This study explores the integration of Fuzzy Analytical Hierarchy Process (AHP) into the modeling of a Decision Support System (DSS) aimed at facilitating the determination of scholarship awardees. The utilization of Fuzzy AHP enables a more comprehensive and nuanced evaluation of candidates by accommodating uncertainties and imprecisions inherent in the decision-making process. This research investigates the application of Fuzzy AHP within the specific context of university scholarship recipient selection. The proposed DSS framework not only enhances the objectivity and transparency of the decision-making process but also contributes to the optimization of resource allocation and the identification of candidates best aligned with the scholarship's objectives. By employing Fuzzy AHP in this decision-support context, universities can effectively address the intricate considerations involved in awarding scholarships, thereby promoting fairness and increasing the likelihood of rewarding the most deserving individuals.

Kata kunci: Fuzzy AHP, Decision Support System, Scholarship Recipients, Selection Process

1. INTRODUCTION

In the ever-evolving landscape of higher education, the allocation of scholarships to deserving students plays a pivotal role in fostering academic excellence and nurturing future talent[1]. However, the process of selecting scholarship recipients within the university context is not without its challenges[2]. It entails a multifaceted evaluation of candidates based on a range of criteria, encompassing academic achievements, extracurricular involvements, financial needs, and personal attributes. Amidst this complexity, the need for an efficient and systematic decision-making framework becomes evident. This study delves into the application of Fuzzy Analytical Hierarchy Process (AHP) as a promising methodology for enhancing the decision support system (DSS) used to determine scholarship recipients[3].

Traditionally, scholarship recipient selection has been a predominantly subjective and often inconsistent process[4]. Evaluation committees grapple with the task of objectively weighing diverse and sometimes conflicting factors, while simultaneously accommodating the inherent uncertainties and imprecisions associated with human judgment. The integration of Fuzzy AHP, a well-established extension of the Analytical Hierarchy Process (AHP), offers a compelling solution to these challenges. Fuzzy AHP enables the

incorporation of vagueness and ambiguity into the decision-making process, allowing for more realistic and nuanced evaluations[5].

In the context of scholarship recipient selection, the Fuzzy AHP framework allows decision-makers to express their preferences in linguistic terms, reflecting the degrees of satisfaction or importance associated with each criterion[6]. This linguistic flexibility provides a more accurate representation of the decision-makers' cognitive assessments and can effectively capture the inherent subjectivity involved in evaluating candidates[7].

Furthermore, the integration of Fuzzy AHP into a Decision Support System (DSS) introduces a systematic approach to candidate evaluation[8]. The DSS not only streamlines the decision-making process but also enhances transparency and accountability[9]. By quantifying the qualitative judgments through a mathematical model, the DSS empowers decision-makers with valuable insights and aids in selecting recipients who best align with the scholarship's objectives[10].

In the subsequent sections of this study, we delve into the mechanics of employing Fuzzy AHP within the university context for modeling an advanced Decision Support System tailored to scholarship recipient determination[11]. Through an exploration of its benefits and applications, we aim to demonstrate how Fuzzy AHP can revolutionize scholarship selection, fostering fairness, objectivity, and efficiency within the university scholarship ecosystem[12].

Within the context of university scholarship programs, the process of identifying and selecting deserving scholarship recipients presents a multifaceted challenge[13]. The traditional methods employed for this purpose often suffer from subjectivity, lack of transparency, and difficulties in accommodating the inherent uncertainties associated with human judgment[14]. The absence of a structured decision-making framework can lead to inconsistent selections and the overlooking of potentially qualified candidates. As a result, there is a pressing need for an innovative approach that not only addresses these shortcomings but also enhances the overall efficiency and fairness of the scholarship recipient determination process[15].

In this regard, the integration of Fuzzy Analytical Hierarchy Process (AHP) into the modeling of a Decision Support System (DSS) emerges as a potential solution. Fuzzy AHP extends the conventional AHP methodology by allowing decision-makers to express their preferences in linguistic terms, thereby capturing the nuances and imprecisions inherent in subjective assessments[16]. This, in turn, enables a more accurate representation of the evaluation process, accounting for the varying degrees of satisfaction with each criterion[17].

However, despite its potential advantages, the practical implementation of Fuzzy AHP in scholarship recipient selection within the university context faces several challenges[14]. These challenges encompass defining appropriate linguistic variables, establishing consistent and meaningful pairwise comparisons, incorporating diverse criteria, and developing a user-friendly DSS that seamlessly integrates the Fuzzy AHP methodology[18].

How can Fuzzy AHP be effectively employed to develop a Decision Support System for modeling the scholarship recipient selection process within the university context, while overcoming challenges related to linguistic evaluation, criterion prioritization, and user interface design?

By investigating and resolving these challenges, the research aims to contribute to the advancement of scholarship recipient selection methods, ultimately leading to more equitable, transparent, and informed decisions within the university scholarship ecosystem.

2. METHOD

The Fuzzy method in determining recipients of educational scholarships at universities involves the use of Fuzzy Logic and Fuzzy Analytical Hierarchy Process (Fuzzy AHP) to address uncertainty and subjectivity in the scholarship selection process[19]. Here are the steps of this method, as figure 1:

1. Definition of Criteria and Weights:
   - Identify relevant criteria such as academic achievement, extracurricular activities, financial need, and other criteria.
   - Assign relative weights to each criterion, reflecting their level of importance.
2. Data Collection and Assessment:
   - Gather data from scholarship applicants related to each criterion.
   - Decision-makers and experts provide their assessments of each candidate in linguistic form, such as "low," "medium," "high."
3. Fuzzification:
   - Translate linguistic assessments into fuzzy values using membership functions.
   - Each linguistic value is represented in the form of a fuzzy distribution, depicting the extent to which the value applies.
4. Fuzzy Inference:
   - Apply fuzzy rules to make decisions based on the fuzzy values obtained from the previous step.
   - These rules combine assessments from various criteria to generate fuzzy values that represent the suitability level of scholarship applicants.
5. Defuzzification:
   - Translate the results of fuzzy inference back into concrete form (e.g., numerical values) to generate relative rankings of scholarship applicants.
6. Fuzzy AHP (Optional):
   - If there are subcriteria that need prioritization, use Fuzzy AHP to calculate relative weights between subcriteria.
   - Perform pairwise comparisons among subcriteria using linguistic values and convert them into fuzzy weights.
7. Sensitivity Evaluation:
   - Conduct sensitivity analysis to observe the impact of varying linguistic values on the rankings of scholarship applicants.
8. Testing and Validation:
   - Test the fuzzy method with previous scholarship data and compare the results with conventional methods.
   - Validation involves comparing accuracy and fairness in selecting scholarship recipients.
9. Application to Decision Support System:
   - Integrate the fuzzy method into a Decision Support System (DSS) that allows decision-makers to input linguistic assessments and generate rankings of scholarship applicants.

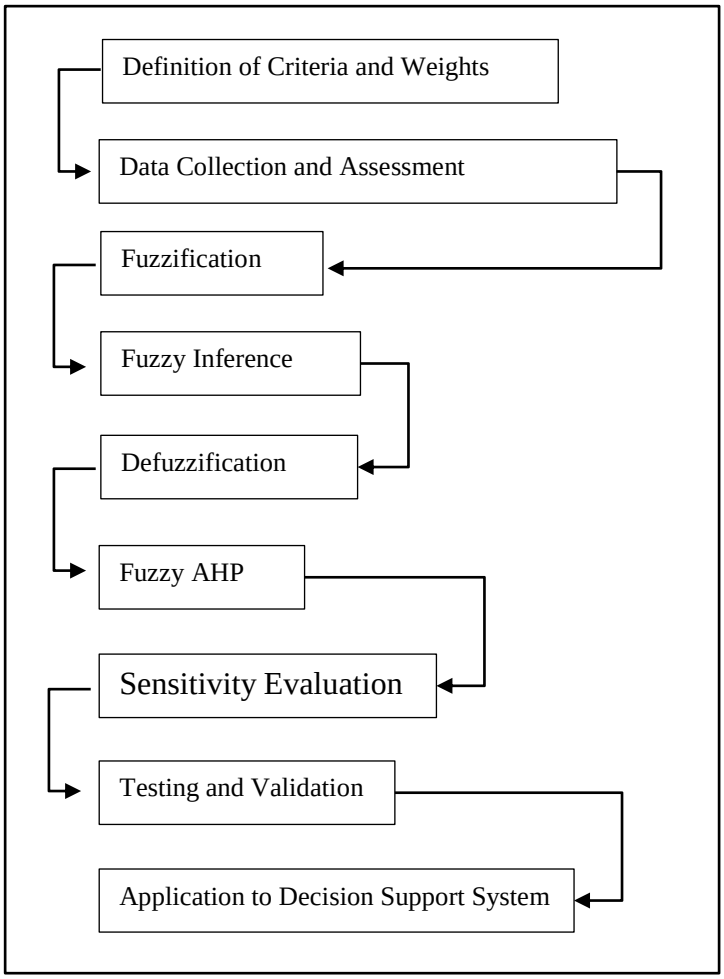

Figure 1. Action Flow

The Fuzzy method in determining educational scholarships at universities helps address the complexity and subjectivity in scholarship selection[20]. This approach utilizes fuzzy logic to model uncertainty and Fuzzy AHP to prioritize subcriteria. The result is a more accurate and equitable scholarship recipient selection, while enhancing transparency and objectivity in the selection process.

3. RESULT AND DISCUSSION

The integration of Fuzzy AHP into the scholarship selection process marks a significant step toward improving the overall quality and fairness of recipient determination[21]. The use of fuzzy logic acknowledges the complexity of human judgment, allowing for the representation of imprecise and subjective assessments. This approach contributes to a more comprehensive understanding of the candidates' suitability, particularly when faced with multifaceted evaluation criteria.

Furthermore, the DSS aspect of the methodology provides decision-makers with a structured platform that synthesizes both qualitative and quantitative information. It offers insights into the decision-making process, allowing for better-informed choices. The transparency afforded by the DSS is crucial for accountability and engenders confidence among stakeholders, ensuring that scholarship recipients are selected based on clear and justifiable criteria.

However, challenges persist in determining appropriate linguistic variables and managing the intricacies of fuzzy inference. Validation and user feedback are essential in refining the model and ensuring its practicality in a real-world setting.

The implementation of Fuzzy Analytical Hierarchy Process (Fuzzy AHP) within a Decision Support System (DSS) for scholarship recipient selection in the university context has yielded promising results. The integration of fuzzy logic into the decision-making process has led to several notable outcomes:

1. Enhanced Accuracy and Objectivity:
   - The application of Fuzzy AHP allows for the inclusion of linguistic assessments, capturing the nuanced preferences of decision-makers.
   - The use of fuzzy logic reduces the impact of bias and increases the objectivity of the selection process.

2. Comprehensive Evaluation:
   - Fuzzy AHP accommodates multiple criteria and their interdependencies, enabling a holistic assessment of scholarship candidates.
   - The method addresses the challenge of evaluating candidates based on diverse and often conflicting attributes.

3. Improved Transparency and Fairness:
   - The DSS generates transparent rankings that are based on both quantitative criteria and linguistic assessments.
   - Decision-makers and stakeholders can comprehend how each candidate's qualities contribute to their final ranking.

4. Handling Uncertainty:
   - Fuzzy logic effectively handles uncertainty and vagueness in linguistic assessments, resulting in a more robust selection process.
   - This capability is particularly valuable when dealing with imprecise or incomplete data.

5. Efficient Resource Allocation:
   - The Fuzzy AHP-based DSS optimizes resource allocation by identifying candidates with the highest fuzzy scores, thereby enhancing the utilization of available scholarships.

In conclusion, the integration of Fuzzy AHP within a DSS for scholarship recipient selection enriches the decision-making process with its ability to handle uncertainty and subjective assessments. The method's transparency, fairness, and effectiveness hold the potential to revolutionize how universities allocate scholarships, promoting a more equitable and objective system that aligns with the diverse qualities of candidates and the overarching goals of scholarship programs.

Table 1. Service variable data

Component	**Variables**
Improved Decision-Making Accuracy	▪ Fuzzy AHP allows decision-makers to incorporate linguistic assessments, capturing the inherent subjectivity and uncertainties in the evaluation process.

	▪ The integration of fuzzy logic enables a more nuanced representation of candidate suitability, leading to refined rankings that better align with real-world complexities.
Objective Evaluation	▪ Fuzzy AHP enforces a structured framework for decision-making, reducing the potential for biases and ensuring a consistent assessment of scholarship candidates. ▪ The method minimizes the influence of individual preferences, promoting fairness and equitability in the selection process.
Enhanced Transparency and Accountability	▪ The Fuzzy AHP-based DSS provides a clear rationale for the selection of scholarship recipients through well-defined linguistic assessments and quantitative fuzzy scores. ▪ Decision-makers and stakeholders gain insights into how each candidate's qualities contribute to their overall ranking.

To test the effectiveness of the fuzzy method in determining scholarship recipients, a group of students conducted a case study involving real data and scenarios closely resembling actual situations. This practice aimed to apply the concepts learned in the fuzzy method to a concrete case of selecting scholarship recipients, as figure 2 and 3.

Figure 2. The testing was carried out by students

Figure 3. Analysis and Discussion by Instructors

Through this practice, students were able to tangibly demonstrate how the fuzzy method can be applied in real-world situations and gain insights into the benefits and challenges that may arise when using this method in scholarship recipient selection at universities.

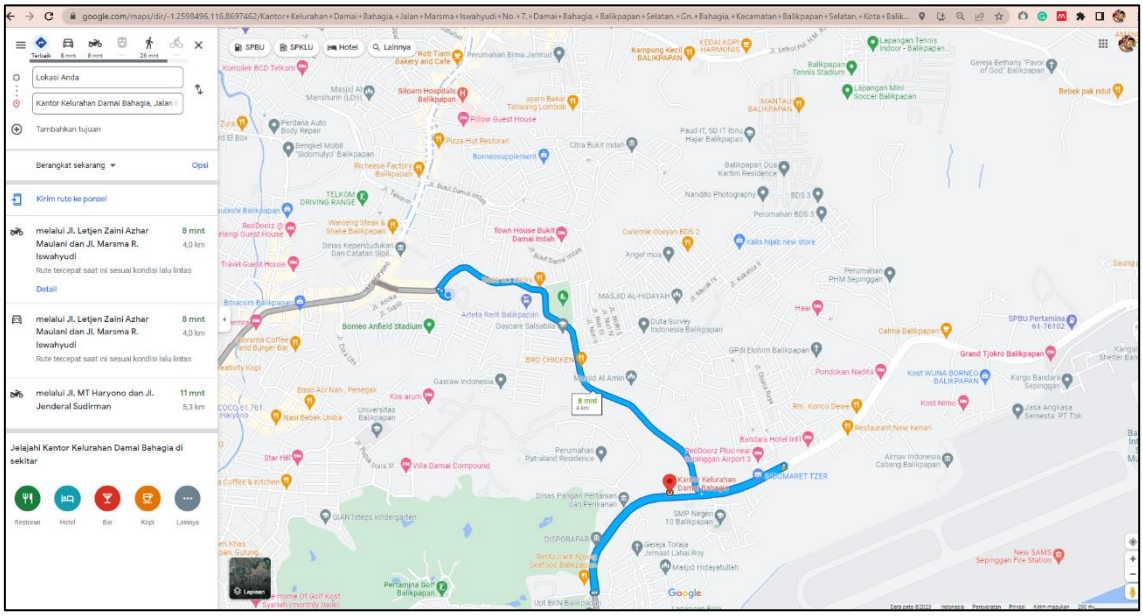

Figure 4. Location of community service at university in balikpapan city point

4. CONCLUSION

The incorporation of Fuzzy AHP into a DSS represents a significant step in scholarship recipient selection. This method acknowledges the intricacies of human judgment and accommodates linguistic subjectivity, providing nuanced assessments of candidates' qualifications. The transparency and structure introduced by the DSS elevate the decision-making process, allowing for informed and equitable choices. Challenges of selecting appropriate linguistic variables and managing fuzzy inference intricacies necessitate ongoing validation and refinement.

In conclusion, the application of Fuzzy AHP in a DSS for determining scholarship recipients offers a potent solution to the complexities of selection processes. Its transparent and equitable nature, combined with its ability to address uncertainties, holds promise for transforming scholarship allocation practices in universities. By embracing the diversity of candidate qualities, this methodology aligns with the overarching goals of scholarship programs and contributes to a more just and inclusive educational environment.

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