# A MULTI-CRITERIA DECISION-MAKING APPROACH FOR TARGETED DISTRIBUTION OF SMART INDONESIA CARD (KIP) SCHOLARSHIPS

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**ASIA e UNIVERSITY**

**2025**

# A MULTI-CRITERIA DECISION-MAKING APPROACH FOR TARGETED DISTRIBUTION OF SMART INDONESIA CARD (KIP) SCHOLARSHIPS

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A Thesis Submitted to Asia e University in
Fulfilment of the Requirements for the
Degree of Doctor of Philosophy

June 2025

## ABSTRACT

Education is fundamental to developing quality human resources, as stated in the 1945 Constitution. To support this goal, the Indonesian government introduced the Smart Indonesia Program through the KIP scholarship for students from underprivileged families. Recipient selection also involves various factors, including poverty indicators, social conditions, and academic performance. This study aims to develop a comprehensive decision-making model for KIP scholarship selection through four main stages. First, the poverty criteria were weighted using three approaches: the Analytical Hierarchy Process (AHP), Entropy, and the hybrid method, followed by a ranking process using the VIKOR method. Second, the clustering process was conducted to group the priorities of prospective scholarship recipients using the K-Means and K-Medoids methods, as well as a combination of PCA+K-Means and PCA+K-Medoids. Third, the classification of scholarship recipient eligibility was performed by comparing the C5.0 and K-Nearest Neighbors (KNN) algorithms. Fourth, the classification results were validated to ensure the accuracy and precision of the decision. The study found that the hybrid weighting model with $\lambda = 0.8$ (80% subjective and 20% objective) achieved a ranking stability of 61%, indicating improved accuracy and consistency in selecting KIP scholarship recipients. Sensitivity analysis showed that Hybrid+VIKOR had the lowest change (1.20%) compared to AHP+VIKOR (5.06%) and Entropy+VIKOR (53.71%), confirming its superior stability against weight variations. In the clustering stage, the combination of PCA+K-Medoids with two initial medoids produced stable clusters in all iterations, suggesting that K-Medoids provided a better representation of data variation. Meanwhile, in the classification stage, the C5.0 algorithm achieved the highest accuracy of 97.27% from a total of 551 data points, with 80% used as training data and 20% as testing data. This study can be utilised to significantly improve decision-making by introducing opportunities for the development of stronger scientific methodologies and contributions, as well as broader practical relevance, especially in supporting transparent, fair, and data-driven scholarship selection processes. Moreover, the developed approach also had the potential to be applied in various other social policy contexts.



**Keywords:** Kip scholarship, poverty criteria weighting, vikor method, clustering, classification

## APPROVAL

This is to certify that this thesis conforms to acceptable standards of scholarly presentation and is fully adequate, in quality and scope, for the fulfilment of the requirements for the Degree of Doctor of Philosophy.

The student has been supervised by: **Prof Dr Titik Khawa Abdul Rahman**

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This thesis was submitted to Asia e University and is accepted as fulfilment of the requirements for the Degree of Doctor of Philosophy.

**Professor Dr Siow Heng Loke**
**Asia e University**
Chairperson, Examination Committee
(26 June 2025)

## DECLARATION

I hereby declare that the thesis submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy is my own work and that all contributions from any other persons or sources are properly and duly cited. I further declare that the material has not been submitted either in whole or in part, for a degree at this or any other university. In making this declaration, I understand and acknowledge any breaches in this declaration constitute academic misconduct, which may result in my expulsion from the programme and/or exclusion from the award of the degree.

**Name: Komang Aryasa**

**Signature of Student**: **Date**: 26 June 2025

## ACKNOWLEDGEMENTS

All praise and gratitude are offered to God Almighty for His grace, love, and guidance, which have enabled me to complete this thesis. This achievement would not have been possible without the support and encouragement of many individuals, to whom I express my deepest appreciation. I am especially grateful to Prof. Dr. Titik Khawa Abdul Rahman, my main supervisor, for her unwavering guidance, insightful feedback, and patience throughout every stage of this work. My sincere thanks also go to the Graduate School of Asia e University for the opportunities and facilities provided during my studies, as well as to the Dipanegara Foundation for their trust and generous financial support through the scholarship program, which significantly facilitated my academic journey. I am deeply thankful to my beloved family my parents, wife, and children for their continuous prayers, motivation, and steadfast emotional and material support, which have been my greatest source of strength. Special thanks are extended to my fellow researchers Erfan Hasmin, Jufri, Indra Samsie, and Muh. Faisal for their technical assistance and meaningful discussions throughout the research process. I sincerely hope that this dissertation contributes to the advancement of scientific knowledge and offers practical benefits. I fully acknowledge its limitations and welcome any constructive suggestions for future improvement.

Finally, I extend my heartfelt gratitude to all who have supported me, directly or indirectly, in the completion of this academic endeavor.

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| | |
|---|---|
| 3T | Disadvantaged, Frontier, and Outermost Areas |
| AHP | Analytic Hierarchy Process |
| C | Criteria |
| CI | Consistency Index |
| CR | Consistency Ratio |
| DPA | Disaster Prone Areas |
| DTKS | Integrated Social Welfare Data |
| KIP | Smart Indonesia Card |
| MCDM | Multicriteria Decision Making |
| P3KE | Targeting for the Acceleration of Extreme Poverty Eradication |
| RI | Random Index |
| SFO | Student From Orphanages |
| VIKOR | Višekriterijumsko Kompromisno Rangiranje |
| Whybrid | Weight Hybrid |
| Wobj | Weight Objective |
| Wsub | Weight Subjective |

# CHAPTER 1

# INTRODUCTION

## 1.0 Background of Study

Since independence in 1945, the Indonesian government has paid great attention to education issues. In the 1945 Constitution of the Republic of Indonesia, this is clearly stated, especially in Article 31 Paragraph 1, which states that every citizen has the right to education (Sekretariat Jenderal MPR Republik Indonesia, 2024). Since then, various steps have been taken to improve the quality of education across the country. The government realizes that the formation of high-quality and competitive human resources at the global level requires education. Therefore, as part of the government's commitment to improving the nation's life, various policies and programs have been implemented, including the Smart Indonesia Program, one of which is the KIP scholarship. This study primarily aims to ensure that Smart Indonesia Card (KIP) scholarships are distributed correctly and in the right amount. This research aims to discover and evaluate mechanisms for selecting applicants and to assess how effective the distribution system is in reaching the target group that needs it most, namely applicants from low-income families. This is because one of the main priorities in providing KIP scholarships is applicants who come from poor families. There are quite a lot of criteria for determining a poor family. Assigning values to criteria in most multi-criteria decision-making (MCDM) models is an important step that needs to be studied thoroughly. The weight of this criterion is very important because it contributes greatly to determining the final result of the decision-making process (Odu, 2019). One of the main challenges in MCDM is determining criteria weights, which should reflect the true priority and value of each criterion under consideration. Thus,

weighting criteria before the ranking process is an important step to ensure that ranking results reflect true priorities, increase accuracy, reduce bias, and support better decision-making. Apart from that, there are several additional indicators that need to be considered when clustering and classifying potential KIP scholarship recipients. These indicators are intended to ensure that scholarship distribution is carried out on target so that recipients who really need it can feel the benefits. By considering these various indicators, clustering and classifying potential recipients can be done more accurately. This will help in determining the right number of scholarships to be given to each recipient so that the allocation of funds becomes more efficient and effective and in accordance with the main objectives of the KIP scholarship program.

Education is one of the means that significantly influences forming quality human resources. Through education, a generation of character can be created that can actualize itself to be the spearhead of civilizational progress. Indonesia is very aware of the importance of education. As stated in the Preamble to the 1945 Constitution, the national purpose of education is to educate the nation's life, which will ultimately support the welfare of the people; therefore, education is a demand or obligation in human life, from childhood to adulthood. Education can help the nation's children improve their family's standard of living and participate in building the nation. Therefore, the Indonesian government created a Smart Indonesia Program, a scholarship program given to students through cash assistance, expanded access, and learning opportunities from the government given to students and students from poor or vulnerable families. This assistance is provided to finance education through the College Smart Indonesia Card (KIP) (Menteri Pendidikan dan Kebudayaan Republik Indonesia, 2020).

The process of selecting and distributing scholarships to those who are eligible and on target is not easy because many variables must be assessed in making decisions for scholarship recipients; therefore, a method is needed that can be used to represent variables as indicators of scholarship eligibility. One of the determining variables in determining the eligibility of scholarship recipients is students from poor or vulnerable families. Second, students come from the 3T area, a frontier, remote, and underdeveloped area that is the gateway to Indonesia's borders. Third, students who come from disaster-prone areas. Fourth, the variable of academic achievement, as stated in a study, is that students who excel in good academic ability are also the priority of this KIP scholarship (Asri Mulyani et al., 2022).

The different economic conditions of Indonesian citizens and a reasonably high poverty index are some of the problems that often hinder the continuity of education of Indonesian children today, especially parents of students in the lower middle class and also students who occupy private universities where scholarship facilities and opportunities, as well as ease of operational costs in receiving education at a university, have opportunities less scholarship aid (Agus Iskandar, 2022). Thus, the government should consider implementing a systematic strategy in managing scholarship offerings to ensure scholarship recipients are effectively selected (Wirawati Dewi Ahmad & Azuraliza Abu Bakar, 2020).

The gap between the number of poor people and the number of applicants is so large that objectivity is needed in determining the priority status of students from low-income families in determining prospective KIP scholarship recipients who come from low-income families using many criteria. A method is needed that can produce a decision to determine the best KIP recipient candidate based on predetermined criteria. A study stated that Multi-Criteria Decision Making (MCDM) is a method used to

evaluate various criteria and choose the ideal among alternatives (Soba et al., 2020). In this study, an MCDM method used which is used to calculate the weight of low-income family criteria is the Analytic Hierarchy Process (AHP) and Entropy and Visekriterijumsko Compromise Rangiranje (VIKOR) in the ranking process. Previous research stated that students who have applied for scholarships should be ranked in deciding the eligibility of scholarship recipients (Amorós, 2023).

With the vast territory of the Unitary State of the Republic of Indonesia which is geographically and socio-culturally very heterogeneous in the provision of education, there are still many problems. Especially in areas classified as frontier, remote, and underdeveloped (3T) (Sugawara & Nikaido, 2014). So that the education and scholarship assistance program can be implemented in accordance with the 3T principles, namely: Right on Target, Right on Amount, and on Time, the Directorate General of Higher Education issued guidelines, students must receive appropriate education for a bright future, including prospective applicants. those from frontier, remote, and disadvantaged areas (3T) who must receive special attention in terms of education (Vania et al., 2021). Apart from that, prospective applicants come from disaster-prone areas, Integrated Social Welfare Data (DTKS) status, Targeting the Acceleration of Elimination of Extreme Poverty (P3KE) status, and KIP scholarship applicants who come from orphanages. However, the fact is that the application of attention to these indicators has not been implemented well so there are still many KIP scholarship applicants who come from these indicators who do not get the opportunity to become KIP scholarship recipients as expected. In order for KIP Scholarships to be given on target and in the right amount, a method is needed that can produce priority groups based on the categories of top priority, medium priority, and non-priority, so that the results of these groupings can be easier to find potential KIP scholarship

recipients who fall into these groups. Therefore, in this research, a comparison of clustering methods was carried out to find the best cluster that will be used in the process of grouping KIP scholarship applicants using clustering techniques, where in one study it was stated that the clustering technique aims to combine several clustering models to produce better output compared to algorithms. individual groupings in terms of consistency and quality (Alqurashi & Wang, 2019).

The provision of scholarships is intended as a form of appreciation given to individuals to continue their education to a higher level. However, the determination of scholarship recipients requires a sound stage. It uses good variable indicators so that scholarship recipients can be selected correctly. As a study, it is stated that the determination of scholarship recipients must consider multi-factor as a determinant to ensure that the recipient is worthy of a scholarship. Therefore, in this study, multi-factor criteria are used through classification techniques so that all criteria that have been determined can be combined in a process as in a study, it is stated that classification is a technique in data mining to group data based on data attachment against sample data (Oktanisa &; Supianto, 2018). The implementation of classification techniques by previous researchers stated that the application of the C50 classification technique could help process data in deciding using classification that provides a significant level of accuracy; therefore, in this study, the C5.0 algorithm will be used for the eligibility classification process for KIP scholarship recipients (Muhammad Furqan et al., 2025). However, to ensure the best clustering results, it is necessary to compare with other classification methods, such as K-Nearest Neighbors (KNN). By comparing the clustering technique with the KNN method, we can evaluate the performance and effectiveness of each approach in grouping data on potential KIP scholarship recipients. This comparison will provide more comprehensive insight into

the advantages and disadvantages of each method so that we can choose the most appropriate technique to produce accurate and consistent groupings.

In general, this research will develop the MDCM technique for distributing KIP scholarships, which can help the government distribute scholarships accurately and with a targeted selection process so that specific, measurable, achievable, relevant, and time-limited goals can be achieved. Process of determining KIP scholarship recipients. One of the main goals of this scholarship program is to ensure that quality education is accessible to all individuals, including those facing financial hardship. By using poverty-level criteria, scholarship programs can prioritize prospective scholarship recipients who need financial assistance to continue their education. Therefore, in this research, the family poverty rate is the main indicator as a condition for granting KIP scholarships, so the weighting process is important to carry out the poverty indicator criteria for prospective scholarship recipients. This is done so that these criteria can be calculated and analyzed mathematically systematically to compare or select several available options or alternatives. In this research, the analytical hierarchy process (AHP) and entropy will be used to weigh the criteria for the poverty level of families of prospective KIP scholarship recipients. The second stage in this research is to compare ranking techniques to find the best ranking technique so that prospective scholarship recipients or the most suitable choice from many potential scholarship recipients can be identified to help make better decisions where the ranking process used in the research is the VIKOR method. The next stage is to compare the clustering process to group prospective scholarship recipients so as to produce groups that have meaningful meaning or interpretation. In this research, the K-Medoid and K-Means methods will be used to prioritize the groups of prospective scholarship recipients. To provide final recommendations for prospective scholarship recipients that are right on

target, the next stage is to carry out the process of classifying prospective scholarship recipients based on all the indicators that have been calculated. Therefore, the classification technique used in this research is C5.0 compared to KNN, with the main aim of building an efficient and accurate decision tree. This decision tree can describe a decision hierarchy based on all indicators of potential KIP scholarship recipients. The final stage in this research is carrying out a validation process, namely ensuring that the results of the decisions or models produced are accurate and reliable in recommending potential scholarship recipients. The validation process in this research uses the confusion matrix method to provide a clear picture of the extent to which the classification model that has been carried out can produce accurate decisions.

## 1.1 Problem Statement

The main problem in this research is ensuring that the KIP scholarship distribution process runs effectively and efficiently, especially in the context of prospective applicants from low-income families, prospective applicants from Disadvantaged, Frontier, and Outermost Areas (3T), Integrated Social Welfare Data (DTKS) status, targeting for the Acceleration of Extreme Poverty Eradication (P3KE) status, student from orphanages (SFO), disaster-prone areas (DPA) including academic grade and non-academic achievement. This research addresses the challenge of identifying and addressing gaps in the implementation of the KIP scholarship program, including how to ensure that scholarships actually reach those who are entitled to them. In addition, this research must also evaluate and compare several of the most effective methods for ranking, clustering and classification processes:

i. The poverty rate in Indonesia is still relatively high and is one of the main challenges in efforts to improve people's welfare. According to the official report