The Mapping of *Huma Betang* Character in Physics Learning Based on Machine Learning (Artificial Neural Network and Fuzzy C-Means)

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ABSTRACT

Background: *Huma Betang* (big house) is a philosophy of the Dayak community and serves as a value instilled in learning at schools in Central Kalimantan. While numerous studies have explored the application and inculcation of *Huma Betang* character values in students, few have quantitatively measured and mapped these characters as part of educational evaluation.

Objective: This study aims to map the profile of the *Huma Betang* character in Physics learning among high school students in Palangka Raya City, Central Kalimantan. The characters measured in this study consist of four pillars: *Hapahari* (kinship), *Handep* (mutual assistance), *Belom Bahadat* (civilized living), and *Hapakat Kula* (mutual consensus).

Method: This study utilized R-Studio software with the Artificial Neural Network (ANN) algorithm to predict character profiles and Fuzzy C-Means (FCM) to cluster the levels of the *Huma Betang* character, which were then compared with the Ideal Standard Deviation (ISD) categorization. This research is a descriptive study involving 290 students from schools in the center and outskirts of Palangka Raya city. The instrument used was in the form of a Situational Judgement Test (SJT) consisting of 23 statement items for the four pillars of *Huma Betang*.

Results: The Ideal Standard Deviation, Artifial Neural Network, and Fuzzy C-Means analyses revealed the existence of six categories: very weak (1), weak (12), moderate (97), lower-strong (80), upper-strong (83), and very strong (17). The strong category contains the most student number, which mean *Huma Betang* character has been internalized by student in Palangka Raya.

Conclusion: The triangulation of the three analytical methods provided a comprehensive profile of *Huma Betang* character, allowing for more targeted character-building interventions, specifically through the integration of students' specific roles in practical activities and physics projects.

Keywords: Artificial Neural Network, Character Measurement, Fuzzy C-Means, *Huma Betang*, Physics Learning.

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INTRODUCTION

Indonesia has initiated character education in the school curriculum to form a generation that is smart, moral, and globally competitive. Pancasila serves as the core value, while local wisdom acts as an amplifier; both are integrated into character education starting from basic schooling. In the Central Kalimantan region, the *Huma Betang* philosophy of the Dayak tribe is a distinct characteristic integrated into character education. *Huma Betang* is a large traditional house occupied by many families as a permanent residence. Mutual assistance, cooperation, tolerance, and kinship are values that must be possessed by every occupant of the house so that no conflicts arise. These characters are expected to be instilled in students in Central Kalimantan through character education. Research on the exploration and inculcation of *Huma Betang* values in students has been widely carried out by previous researchers. These values are cultivated through classroom learning, such as natural sciences, social sciences learning, counseling guidance, and extracurricular activities (Herman et al., 2022; Setiawan & Riadin, 2021; Sugiyanto et al., 2019; Sunaryo et al., 2021). The inculcation of the *Huma Betang* philosophy can impact students' sense of togetherness and ecoliteracy knowledge (Maresty & Zamroni, 2017; Sihotang & Karliani, 2024).

In the context of science learning, specifically physics learning, the cultivation of the *Huma Betang* philosophy can be conducted through group learning and scientific investigations in the laboratory. During experiments, students must help each other when a peer has difficulty assembling equipment or recording data. In the discussion process to conclude, students must agree on the interpretation of the obtained data. The value of respecting others' opinions can be formed through this process. Every experiment group must be able to obey laboratory rules and occupational safety procedures. At the same time, an educator must be able to build a safe classroom climate where students are not afraid of making mistakes when expressing their opinions.

However, there is a lack of research measuring and mapping the *Huma Betang* character profile among students in Central Kalimantan. In fact, this measurement is needed to evaluate character education and the inculcation of the *Huma Betang* philosophy in Central Kalimantan, especially after many studies reported a decline in students' affect following online and distance learning during the COVID-19 pandemic (Estikasari & Pudjiati, 2021; Juliandarini, Sudira & Mutohhari, 2023; Prigantini & Abdullah, 2022). To fill the existing research gap, this study was conducted to measure and map the profile of high school students' *Huma Betang* character in physics learning in Palangka Raya City, Central Kalimantan province.

The *Huma Betang* character measured in this study consists of four pillars, namely *Hapahari* (kinship), *Handep* (mutual assistance), *Belom Bahadat* (civilized living), and *Hapakat Kula* (mutual consensus). These four pillars serve as references in developing the *Huma Betang* character measurement instrument. Several studies on measuring character based on local wisdom have been conducted by other researchers (Sa'adah, Ita, & Fitriah, 2024; Masruri, Munali, & Sumiati, 2021; Widyastama, Suja, & Arnyana, 2025). These studies used a Likert scale for their instrument construction, with the technical application of data analysis in the form of standard deviation analysis (Sa'adah, Ita, & Fitriah, 2024), regression (Widyastama, Suja, & Arnyana, 2025), and Rasch modeling (Masruri, Munali, & Sumiati, 2021) for interpretation.

This study uses the Situational Judgement Test (SJT) as the measurement item construction. The SJT is used because it can measure attitudes more accurately based on a person's intentions compared to a traditional Likert scale (Rasmussen, 2010).

Furthermore, this study will apply Artificial Neural Network (ANN) and Fuzzy C-Means (FCM) clustering analyses. Artificial Neural Networks (ANN) are computational models inspired by biological neural networks, used here to predict character profiles based on response patterns. In this study, the ANN analysis is used to predict the category of students' *Huma Betang* character from item response patterns. Then, FCM is an unlabeled grouping method that divides respondents into certain clusters based on the similarity of their answers. FCM functions to map latent categories that are not fully revealed by ANN. The final categorization obtained becomes a standard reference for measuring the *Huma Betang* character in the future. In addition, the revealed profile of students' *Huma Betang* character can serve as a reference for teachers and schools to evaluate the character learning implemented so far and determine the follow-up actions that can be taken.

METHODS

Study Design and Participants

This research is a descriptive study that aims to map and describe a phenomenon using scientific methods and measurement tools. In this case, the phenomenon studied is the *Huma Betang* character of high school students in the city of Palangka Raya. The targeted sample is grade XI students because learners at this level have completed half of their education at their respective schools. Then, the instrument package was compiled so the measurement could run effectively and efficiently; the obtained data were then analyzed to determine their interpretation. The research concludes by compiling a report containing research recommendations; the entire research flow can be seen in Figure 1 below.

Figure 1 Research's flowchart

Participants were selected using multistage sampling, combining purposive sampling for sub-districts and random sampling for schools and classes. The stages referred to are the selection of sub-districts using purposive sampling in the first stage, the selection of schools using random sampling in the second stage, and the selection of classes using random sampling in the final stage. This method was chosen because it provides flexibility as well as broad coverage, according to research needs. A total of 290 respondents from four schools in two sub-districts in Palangka Raya City participated in this study. Details of the sample distribution is shown in Table 1.

Ethical Approval Statement

This research was conducted in accordance with ethical standard of institution research committee of Universitas Palangka Raya and received approval from the ethical committee with the assigned approval number 2297/UN24.13/KP/2026. The participation in the Situational Judgment Test was entirely voluntary. Informed consent was obtained from all individual participants prior to the data collection process. To ensure confidentiality, all student and schools were anonymized during analysis phase, and no personally identifiable information is disclosed in this article.

Table 1 Sample Distribution

District	Schools	Total Classes	Sample Classes	Total Students
Pahandut	SMA A	6 classes	XI MIPA-1	36
			XI MIPA-5	37
	SMA B	6 classes	XI MIPA-2	36
			XI MIPA-6	36
Jekan Raya	SMA C	5 classes	XI MIPA-2	37
			XI MIPA-3	36
	SMA D	4 classes	XI MIPA-1	35
			XI MIPA-4	37
Total				290

Research Instruments

The indicators for the *Huma Betang* character measurement in this study consist of four pillars, namely *Hapahari* (kinship), *Handep* (mutual assistance), *Belom Bahadat* (civilized living), and *Hapakat Kula* (mutual consensus). These pillars are used as references in preparing the measurement instruments in the situational judgement test (SJT). The SJT is a form of test that presents certain situations and choices in the form of possible actions to be taken in those situations. The tendency of the respondent's character is measured based on the action taken because each choice has a different score level. There is a total of 23 items in the *Huma Betang* character measurement instrument used in the study. Table 2 presents the instrument blueprint.

Table 2 Huma Betang measurement instrument

Pillar	Definition	Item
Hapahari (kinship)	The attitude of togetherness and living in harmony with others	1, 2, 3, 4, 5, 6
Handep (mutual assistance)	The attitude of mutual assistance and cooperation	7, 8, 9, 10, 11, 12
Belom Bahadat (civilized living)	The attitude of politeness and obedience to rules	13, 14, 15, 16, 17, 18
Hapakat kula (mutual consensus)	The attitude of deliberation for consensus in making decisions and respecting others	19, 20, 21, 22, 23

Examples of SJT items to measure the *Handep* and *Hapakat Kula* pillars are shown in Table 3 below. The *Handep* (mutual assistance) item presents a situation where the class president is given a lot of work by the teacher, and there are four actions that a respondent might choose when in that situation. If the respondent chooses to ask other friends to help the class president, then they get the highest score. However, if they leave the class president with the task because they feel there is no obligation to help, then the respondent gets the lowest score. Then, the *Hapakat Kula* item presents a situation when an opinion is not accepted in a group discussion. If the respondent feels disappointed and is therefore unwilling to be involved in the discussion anymore, then they obtain the lowest score. Conversely, if they are open-minded and accept the group's decision, then they get the highest score for the *Hapakat Kula* pillar. The *Huma Betang* character instrument has been validated and declared valid by experts (Dinata et al., 2024). Then, item response theory (IRT) analysis using the Partial Credit Model (PCM) on field trial data showed that the *Huma Betang* character instrument is empirically valid with a reliability of 0.87 (Dinata et al., 2022).

Table 3 The Example of *Huma Betang* Measurement Items

Pilar	Item	Characteristics
Hapahari	A friend invites me to join an association consisting only of smart students. The action I will take is … .	Inf. MNSQ = 1.07
	a. feel happy because I am considered smart and agree to join (2 poin)	Infit t = +1.1
	b. joining because it will definitely be beneficial for me (1 poin)	
	c. refusing the request because I do not want to discriminate against friends (4 poin)	
	d. considering the positive and negative aspects of joining the group (3 poin)	
Handep	When the Physics lesson ends, the teacher asks the class president to return the spring scales, iron balls, calipers, protractors, stopwatches, and measuring tapes to the laboratory. The action I will take is … .	Inf. MNSQ = 1.00
	a. assisting the class president if he ask for help (2 poin)	Infit t = 0.0
	b. letting the class president execute the duties that have been ordered (1 poin)	
	c. helping the class president without being asked or told (3 poin)	
	d. inviting other friends to help the class president (4 poin)	
Belom bahadat	During the final semester exam, I see a friend searching for answers on the internet. The action I will take is … .	Inf. MNSQ = 0.92
	a. reporting it to the teacher (4 poin)	Infit t = -1.2
	b. following to search for answers on the internet to be fair (1 poin)	
	c. just letting it be and tolerate it (2 poin)	
	d. not justify it, but I also do not want to report it to the teacher (3 poin)	
Hapakat kula	During a group discussion about global warming solutions, my opinion is not accepted by my friends. The attitude I will take is … .	Inf. MNSQ = 0.98
	a. accepting it even though I feel disappointed because my opinion is not accepted (3 poin)	Infit t = -0.4
	b. disappointed and not want to give an opinion again in the group discussion (1 poin)	
	c. accepting the result because it has been decided together (4 poin)	
	d. ask my friends to reconsider my opinion (2 poin)	

Data Analysis

The measurement of the *Huma Betang* character produces data in the form of an ordinal scale. To be analyzed further, these interval data were converted into ordinal data through the Method of Successive Interval (MSI) so that the scores could be calculated using descriptive statistics to make them more meaningful. The respondents' *Huma Betang* scores were categorized based on the ideal standard deviation (ISD) equation to become factual categories (Table 4). This categorization was subsequently compared with the category readings from the ANN and FCM analyses.

Table 4 *Huma betang* categorization based on ISD

Score Interval	Category
$x > 3{,}4$	Very Strong
$2{,}8 < x \leq 3{,}4$	Strong
$2{,}2 < x \leq 2{,}8$	Moderate
$1{,}6 < x \leq 2{,}2$	Weak
$x \leq 1{,}6$	Very Weak

The Artificial Neural Network algorithm analyzes the interval data from the MSI to predict the categorization of the respondents' *Huma Betang* character to be compared with the actual categories. The ANN is designed through a programming language to be able to study respondents' answer patterns and make categorizations based on those patterns. The ANN architecture comprised three layers: an input layer (representing the four *Huma Betang* pillars), a hidden layer (for pattern recognition), and an output layer (predicting character categories). The input layer is the *Huma Betang* data consisting of four pillars, which are *Hapahari*, *Handep*, *Belom Bahadat*, and *Hapakat Kula*. The hidden layer is formed by an independent learning process by the artificial neural network to generate hidden neurons from the *Huma Betang* pillars. Each neuron in the hidden layer works together to read the input layer and determine the weights of the relationships between interconnected neurons (Faul, 2020). The artificial neural network then determines the category of the students' *Huma Betang* character in the output layer based on the pattern of relationships among the neurons (Graupe, 2013). In this case, the categories of *Huma Betang* character requested in the ANN output number five: Very Strong, Strong, Moderate, Weak, and Very Weak. An illustration of how the ANN layer model works can be seen in Figure 2 below.

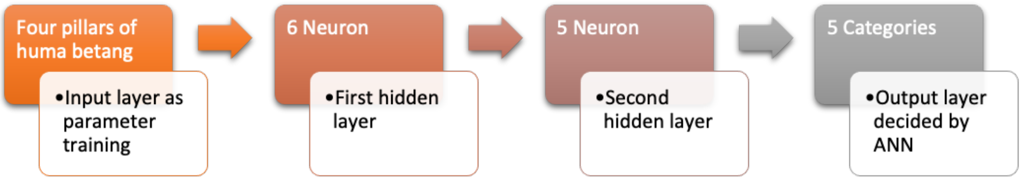

Figure 2 Illustration model of Artificial Neural Network layers

Furthermore, this study used Fuzzy C-Means (FCM) Clustering analysis to deepen the categorization of the *Huma Betang* character that had been predicted by the ANN. The FCM method can group data based on the similarity of answer patterns from respondents. Each piece of data can have a degree of membership in more than one cluster, so the data displayed can be more comprehensive (Miyamoto et al., 2008). Each *Huma Betang* pillar score will be compared with the total *Huma Betang* score of each student on a two-dimensional coordinate axis. In total, there will be 4 images, each containing the coordinate points of each respondent.

RESULTS

The *Huma Betang* character instrument uses an ordinal scale with levels 1 – 4, so the scores obtained from the survey cannot be analyzed directly with general descriptive or parametric statistics. This is because the values 1 to 4 only indicate an order, while the distance between categories is not necessarily the same. For example, the distance between "agree" and "strongly agree" on a four-point Likert scale is not necessarily the same distance as "disagree" to "agree". Therefore, the method of successive interval (MSI) analysis is applied to convert ordinal data into interval data by calculating the distance between categories based on the distribution of answers. As a result, each measurement item has a new weight (interval score) that is more proportional. Answer choice 1 on a measurement item will change to a new value, such as 1.2 or 1.3. Then, answer choice 1 on another measurement item number can also show a different result again, such as 1.1 or 1.25, depending on the distribution answers on that item.

The data on the *Huma Betang* character of high school students in physics learning in the city of Palangka Raya that have been transformed through MSI show an average score of 2.88 (Table 5). As shown in Table 5, the mean scores for *Hapakat Kula* (M=3.02) and *Handep* (M=2.90) were higher than those for *Hapahari* (M=2.81) and *Belom Bahadat* (M=2.80), indicating stronger internalization of these values. The highest maximum score belongs to the *Hapakat Kula* (3.72), while the lowest maximum score belongs to the *Hapahari* (3.57). On the other hand, the *Hapakat Kula* is also the pillar that has the lowest minimum score (1.24), which makes this pillar have the largest standard deviation compared to the other pillars (0.47). Table 5 also shows small standard deviation values (0.36 – 0.47), which can be interpreted as indicating that the distribution of student answers is quite uniform, but still holds adequate variation to be analyzed further. This means that the internalization of *Huma Betang* values is quite consistent among students.

Table 5 Description of Survey Result

Pillar	Minimum	Maximum	Mean	Standard Deviation
Hapahari	1,25	3,57	2,81	0,45
Handep	1,39	3,68	2,9	0,45
Belom Bahadat	1,45	3,69	2,8	0,46
Hapakat Kula	1,24	3,72	3,02	0,47
Huma Betang	1,43	3,62	2,88	0,36

The results of the *Huma Betang* character measurement were categorized based on Table 4 and the summary is shown in Table 6 below. Based on the categorization in Table 4, the strong and moderate categories contain the most respondents, with a total of 163 (56.21%) and 97 (33.45%). Then, the very strong, weak, and very weak categories have amounts of less than 10%, which are 17 (5.86%), 12 (4.14%), and 1 (0.34%). These proportions show a normal distribution curve that leans towards the strong category. The results of this ISD categorization will subsequently be compared with those of the ANN and FCM analyses.

The Artificial Neural Network (ANN) makes category predictions by studying respondents' answers and creating categorizations based on the patterns that emerge. Figure 3 shows a visualization of the artificial neurons and hidden layers formed by the ANN based on the input of the four *Huma Betang* character pillars. The black arrows and numbers indicate the weight of the relationships between neurons, where the magnitude of the number indicates the relationship strength, while the positive or negative sign indicates the direction. A large positive weight (e.g., +5.61) means that the pathway has a strong contribution to direct to a certain category. On the other hand, a large negative weight (such as -4.69) indicates that the relationship suppresses influence so that specific input does not lead to that category. The ANN analysis revealed that the *Belom Bahadat* pillar exhibited the most consistent and dominant weightings, suggesting it is the most influential factor in determining character categorization. This means that this pillar is considered more dominant and more influential in determining character categorization.

Table 6 Respondents Character Categorization on ISD

Category	Total Respondents	Percentage
Very Weak	1	0,0034
Weak	12	0,0414
Moderate	97	0,3345
Strong	163	0,5621
Very Strong	17	0,0586

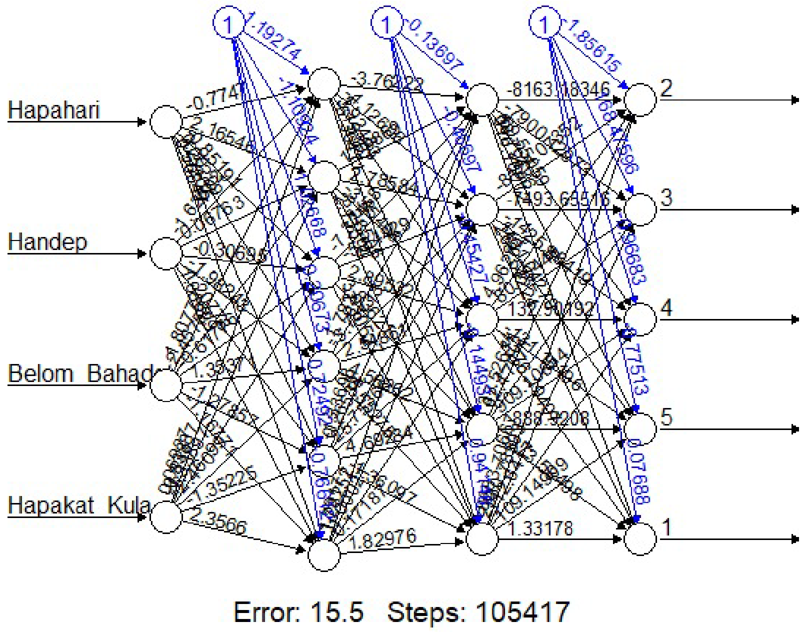

Figure 3 Visualization model of Artificial Neural Network for Huma Betang category

The ANN output shows the calculation steps performed 105,417 times to study the respondents' answer patterns with an error of 15.5. Around 70% of the respondent data was used by the ANN to learn patterns. Then, the next 15% was used to validate the pattern, and the remaining 15% for trials. Based on the learned patterns, the ANN can predict the category of the *Huma Betang* character possessed by a student. The comparison of ANN prediction to the ideal standard deviation category on the *Huma Betang* character is shown in Table 7, which shows slightly different results. According to the ANN predictions, there are no respondents who have a "very strong" character. The model suggested that respondents initially categorized as 'Very Strong' did not exhibit distinct response patterns compared to the 'Strong' group, leading the ANN to reclassify them into the 'Strong' category. More data on students categorized as "very strong" is needed so that the model can learn the characteristics of the emerging patterns.

The evaluation of the ANN analysis performance on the *Huma Betang* character in Table 8 shows that the analysis accuracy reaches 94.13%, which is considered high. The confidence interval is between 0.9037 and 0.9628, with a 95% level. This means that if the analysis is repeated many times, there is a 95% probability that the accuracy will reach 90.37% to 96.28%. A narrower confidence interval indicates that the model is more stable and consistent. Furthermore, the No Information Rate value in Table 8 (56.2%) is much lower than the accuracy level (94.13%), which shows that the ANN model learned data patterns, not by guessing the majority category. The reliability of this analysis is indicated by a Kappa value of 0.8845, which according to Landis & Koch (1977) falls into the "almost perfect" category. This evaluation shows that the ANN analysis can be relied upon as a tool to map students' *Huma Betang* characters.

Table 7 Confusion Matrix of Neural Net Result

ISD's Category	**ANN's Prediction**					**Total**
	Very Weak	**Weak**	**Moderate**	**Strong**	**Very Strong**	
Very Weak	1	0	0	0	0	1
Weak	0	10	2	0	0	12
Moderate	0	0	97	0	0	97
Strong	0	0	0	163	0	163
Very Strong	0	0	0	17	0	17
Total	1	10	99	180	0	290

Table 8 Model Evaluation Statistic

Metric	**Value**
Accuracy	0.9413 (94.13%)
Confidence Interval 95%	0.9037 – 0.9628
No Information Rate (NIR)	0.562
P-Value (Acc > NIR)	< 2.2e-16
Kappa	0.8845

Subsequently, FCM analysis was also conducted on the *Huma Betang* character scores that had been converted to an interval scale and grouped based on the answer patterns on the *Huma Betang* pillars. The visualization of the FCM analysis clusters is shown in Figure 4, which displays points representing the number of respondents. The X-axis and Y-axis, respectively, show the total *Huma Betang* character score and the score per pillar. Based on the proximity of patterns among respondents, FCM provides five clusters with different colors: cluster 1 (green), cluster 2 (red), cluster 3 (purple), cluster 4 (yellow), and cluster 5 (blue). Cluster 1 is a group that represents a weak *Huma Betang* character because they are predominantly located at the bottom of the graph. Cluster 2 has the highest number and fills the middle area, so they are interpreted as respondents with a moderate category score. Clusters 3 and 4 are in the upper right part of the graph, indicating these groups have a stronger category. Then, cluster 5 shows an accumulation at the top of the graph as the cluster with the strongest categories.

Figure 4 provides meticulous information regarding the characterization of each respondent category. On the *Hapahari* and *Handep* pillars, Cluster 1 (green) is clearly separated at the bottom of the graph, while Clusters 2 (red) to 5 (blue) get closer together toward the top. The data show a clear gradation from weak groups to strong groups in the *Hapahari* and *Handep* pillars. In addition, the *Handep* graph, which is denser than the *Hapahari* graph, provides information that its scores are more homogeneous. Furthermore, the *Belom Bahadat* pillar has quite sharp transitions and linearity between clusters, with the yellow and blue clusters piling up at the top. This pillar can distinguish well for respondents with high categories. The *Hapakat kula* pillar shows a more varied distribution with mixed and overlapping clusters. It can be concluded that this pillar is not as clear as *Belom Bahadat* in separating categories. Another thing revealed by Figure 4 is that the characteristics between clusters can resemble those of their neighboring clusters. For example, Cluster 4 (yellow) has a score distribution like Cluster 3 (purple) for the *Hapahari* and *Handep* pillars.

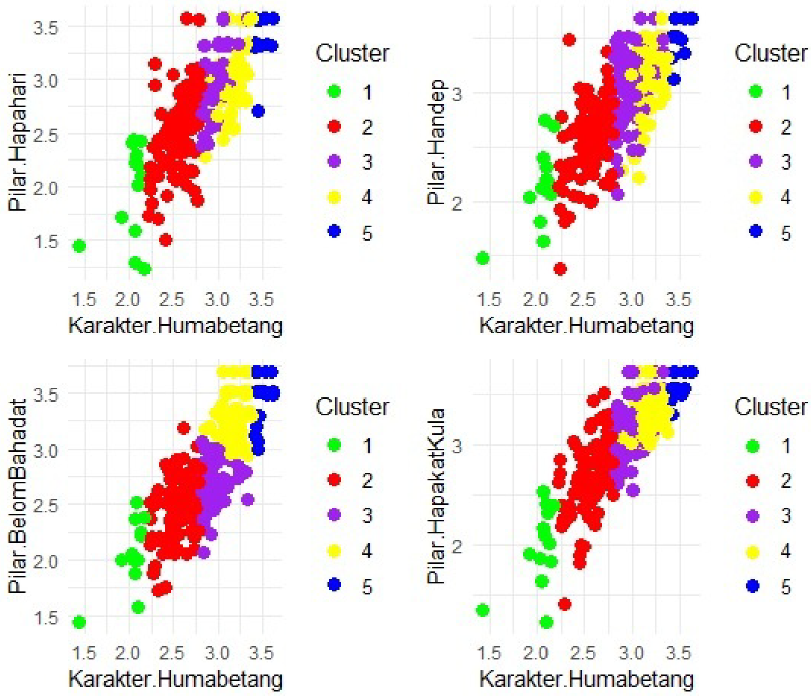

Figure 4 Visualization of *Huma Betang* clustering

However, in the *Belom Bahadat* and *Hapakat Kula* pillars, the characteristics of the score distribution for Cluster 4 (yellow) resemble those of Cluster 5 (blue). Notably, FCM identified a sub-category (Cluster 4) within the 'Strong' group, distinguishing between 'Lower-Strong' and 'Upper-Strong' levels—a nuance not captured by ISD or ANN.

DISCUSSION

The details of the categorization comparison from the ISD, ANN, and FCM analyses are shown in Table 9, which complement each other. The table shows that respondents categorized as "weak" and "very weak" by ISD and ANN are considered as one cluster by FCM. Another difference lies in the categorization of the upper group; if previously, ANN lowered the category of 17 respondents to "strong", then the FCM analysis re-grouped the 17 respondents into the "very strong" category, similar to the ISD category. In addition, FCM succeeded in reading the existence of sub-categories within the "strong" category; previously, ISD calculated respondents in the strong category as 163 respondents. The category was divided by FCM into two groups, which are the lower-strong group with an amount of 80 and the upper-strong group with an amount of 83.

Table 9 *Huma betang* character category comparison

Category	ISD	ANN	FCM
Very Weak	1	1	13
Weak	12	10	97
Moderate	97	99	80
Strong	163	180	83
Very Strong	17	0	17

The differences in the results of the three analysis methods are not errors, but reflections of the characteristics of each analysis. ISD divides respondent categories based on standard deviation categories, thus having clear boundaries between categories (deterministic). However, this analysis does not consider internal variance or answer patterns among respondents. Then, the ANN analysis has an accurate ability to recognize patterns in dominant categories. However, it has limitations in detecting categories with small amounts of data. On the other hand, FCM analysis provides a more spread-out category distribution and a more comprehensive picture. It is also able to reveal the existence of sub-categories through internal variations that certain categories might possess. Even so, FCM analysis requires more detailed interpretation efforts due to the complexity of the information provided.

Character education has several stages for character formation in students. The first stage begins with an introduction to values. The second stage is the stage where students commit to carrying out a value. The third stage is the process of characterizing values through long-term implementation. Therefore, teachers can provide interventions at school in the first stage through the introduction of values. However, the second stage (commitment) is an internal process driven by student agency and cannot be directly forced by educators. Students may know or memorize a value, but they are not necessarily willing to implement it. Therefore, the educators' task is to create as many triggers as possible for students, so they feel that a "value" is important and beneficial.

The results of mapping the *Huma Betang* categories show that respondents possess characters ranging from "very weak" to "very strong". The very weak category means that respondents show almost no internalization of *Huma Betang* values. They tend to be passive and care less about togetherness. For students in this category, educators can provide basic interventions through instilling values via stories, discussions, and direct role models. Respondents in the weak category mean they already know the *Huma Betang* values but have not consistently applied them. They "know" but do not yet "believe" and "are not accustomed"; teachers need to identify students in this category to be given motivational reinforcement and intensive mentoring, as a value is not only to be understood but also needs to be lived. For students in this category, assigning structured technical roles during experiments (e.g., timekeeper or equipment manager) can help foster responsibility and engagement. Direct assistance while they work at the practicum table is highly needed (Diana et al., 2022).

The "moderate" category has the largest number in this study. This category means that respondents possess an understanding and application of values fairly but are not yet stable in all situations. Sometimes they behave according to *Huma Betang* values, sometimes they do not. This group is the "average" group that can be directed to a higher category if given the right stimulation. However, they are also at risk of falling into a lower category if not fostered. Students in this category need routine activities and active roles to strengthen habituation. The use of students' worksheets that contain peer-assessment rubrics during the completion of physics projects (Topulu & Sianipar, 2023), which can be an effective trigger instrument so that they feel "observed" and consistently maintain the *Handep* or *Hapakat Kula* pillars during discussions.

The "strong" group has two sub-categories: "lower-strong," which leans toward the moderate category, and "upper-strong," which leans toward the very strong category. The lower-strong category refers to respondents who are already above average and show good *Huma Betang* values, but there are still inconsistencies in their application. This group is strong in the *Hapakat Kula*, but weak in the *Belom Bahadat*. Small leadership exercises or simple rewards can be an option to strengthen their internal motivation. On the other hand, the upper-strong category consists of respondents who are already stable in applying *Huma Betang* values. They are consistent in helping friends, having good character, and respecting others. This group can be given greater responsibilities as role models of *Huma Betang* values to their friends, such as becoming group leaders in Project-Based Learning (PjBL), which has long-term projects (Ariyanto, 2022). The coaching challenge for teachers is to train them to distribute the workload fairly without dominating group performance.

Respondents in the "very strong" category are respondents who truly embody the *Huma Betang* philosophy fully. They have high integrity, solidarity, empathy, and responsibility. Their numbers are indeed small, but their presence is important as role models in the class. Students in this category can be given strategic leadership roles, such as student council president, school ambassador, or competition representative. In physics learning, they are a strategic class asset to be involved in peer-mentoring programs. They can be encouraged to become facilitators for small groups in helping to bridge their friends' understanding.

CONCLUSION

This study successfully mapped the *Huma Betang* character profile of high school students in Palangka Raya using a tripartite analytical approach: Ideal Standard Deviation (ISD), Artificial Neural Network (ANN), and Fuzzy C-Means (FCM). The research results indicate that students' characters are distributed into six categories: very weak, weak, moderate, lower-strong, upper-strong, and very strong. While ISD provided a baseline factual categorization, ANN demonstrated high accuracy (94.13%) in predicting dominant categories, albeit with limitations in identifying minority groups. Conversely, FCM uncovered internal variations within the 'Strong' category, differentiating between 'Lower-Strong' and 'Upper-Strong' sub-groups. The differences in these three methods enrich the understanding of student profiles, which are mostly in the moderate to strong categories, with only a few in the extreme categories. These findings serve as an important foundation for schools and educators in designing more directed and contextual *Huma Betang* character-building strategies, particularly within the physics learning environment. These strategies can be realized starting from the assignment of structured technical roles in laboratory practicum activities for the weak group, habituation through peer assessment rubrics in groups for the moderate category, assigning responsibilities in experimental projects for the strong group, and strategic involvement as peer-mentoring facilitators for the very strong group.

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CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

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