Zero : Jurnal Sains, Matematika, dan Terapan
E-ISSN : 2580-5754
P-ISSN : 2580-569X
Vol. 7, No. 1, Juni 2023
pp. 09-13

Ranking Factors Affecting Student Academic Achievement With Fuzzy AHP Method

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Article Info

Article history:

Keywords:

AHP
SMP Negeri Sei Bingai
Rangking Factors

ABSTRACT

There are many factors that influence student achievement, including internal and external factors. Internal factors include physical factors such as health and disability, psychological factors including intelligence, attention, interest, talent, motive, maturity, and readiness, and fatigue factors such as physical and mental fatigue. Meanwhile, external factors consist of family factors such as parenting, educational background, family relationships, home atmosphere, family economy, parental understanding, and cultural background. Finally, community factors include student activities in the community, the influence of mass media, social friendships, and forms of community life. This paper examines the impact of physical, psychological, family, school, and community factors on students' academic achievement, with a particular focus on those who attend public junior high schools in Sei Bingai District, Langkat Regency. In this research, the data collection methods that the author uses are as follows: 1) Research Observation, 2) Interview, and 3) Documentation. The data source of this research is through a sample of public junior high school students in the Sei Bingai sub-district of Langkat Regency which is 100 students to find out what factors influence student learning achievement. The variables used in this study are as follows: Physical (x_1), Psychological (x_2), Family (x_3), School (x_4), and Community environment (x_5). Furthermore, data analysis techniques were carried out using Fuzzy AHP. This study identifies physical influences as the main determinant for public junior high school students in Sei Bingai sub-district in their learning achievement. The application of Fuzzy Analytic Hierarchy Process (AHP) data analysis technique revealed that the environment element showed the largest average compared to other factors.

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1. INTRODUCTION

The main purpose of education is to foster and improve students' knowledge, skills and behaviors, enabling them to effectively apply their acquired abilities in the broader context of society. According to Chapter I Article 1 of the National Education System Number 20 of 2003, education is characterized as a deliberate and organized effort aimed at creating an environment conducive to learning and facilitating a process through which learners actively develop their innate abilities. The ultimate goal is to foster the

development of spiritual resilience, religious understanding, self-discipline, individuality, intellectual intelligence, noble morals, and skills necessary for personal, community, nation, and state advancement.

Many factors influence student achievement, including internal and external dimensions. Internal factors include various elements, including physical aspects such as health and disability, psychological factors such as intelligence, attention, interest, talent, motive, maturity, and readiness, and fatigue factors such as physical and mental fatigue. External influences include various aspects related to the family, including parenting, educational background, family relationships, home atmosphere, family economy, parental understanding, and cultural background. In addition, school factors summarize various elements such as learning strategies used by teachers, curriculum design, teacher-student interaction, student interaction, school policies, educational resources, school scheduling, lesson benchmarks, facility conditions, learning approaches, and homework assignments. The community aspect includes various elements such as student involvement in social activities, the impact of mass media, social relationships, and various forms of community involvement. This study examines the influence of several environmental elements, including physical, psychological, family, school, and community factors on student academic achievement, namely students attending public junior high schools located in Sei Bingai District, Langkat Regency using the Fuzzy Analytical Hierarchy Process (FAHP) method.

2. RESEARCH METHODE

In this research, the data collection methods that the author uses are as follows: 1) Research Observation, 2) Interview, and 3) Documentation. The data source of this research is through a sample of public junior high school students in the Sei Bingai sub-district of Langkat Regency which is 100 students to find out what factors influence student learning achievement. The variables used in this study are as follows: Physical (X_1), Psychological (X_2), Family (X_3), School (X_4), and Community environment (X_5). Furthermore, data analysis techniques are carried out using Fuzzy AHP.

The computer program used is a Microsoft Excel template designed by [1]. The analysis methods used to achieve the objectives in this study are described as follows:

a. Identify the elements that are most important in influencing student learning achievement. This entails providing a comprehensive definition of the problem, as well as a detailed description of the aforementioned factors. A hierarchical structure is established to determine the selection criteria that students use in assessing the aspects that affect their academic performance. The factors include physical, psychological, family, school, and community environments.
b. To assess the accuracy and consistency of the questionnaire. A valid and reliable questionnaire was used for data collection purposes. The survey was conducted on a sample of 100 participants using purposive sampling technique.
c. To determine the matrix for pairwise comparison based on the data provided by each respondent for each level of criteria. The priority vector of elements on each criterion in the hierarchy is calculated. The calculation of the priority vector is obtained by calculating the eigenvector. Furthermore, calculating the largest eigenvalue.
d. Consistency tests are carried out on each pairwise comparison matrix. If the condition CR ≤ 10% is met, it can be concluded that the matrix is consistent. If the pairwise comparison matrix shows inconsistency, appropriate action is taken to correct the inconsistency.
e. The geometric mean is calculated for each criterion and sub-criteria, followed by pairwise comparison based on the rounded geometric mean calculation results.
f. The process of converting pairwise comparison weights into triangular fuzzy numbers. The synthetic extent fuzzy value for each criterion and sub-criteria is determined based on the matrix.
g. The objective of this study is to compare the fuzzy synthetic extent values. The minimum value is selected from the findings obtained from the comparison of fuzzy synthetic extent values. Then determine the normality of the weight vector and identify the minimum value.

3. RESULT AND ANALYSIS

Before analyzing the data using the Fuzzy Hierarchical Analysis Process method, the questionnaire was subjected to preliminary testing to assess its validity and reliability. Experiments were conducted on a sample size of 28 students from 3 public junior high schools in Sei Bingai District, Langkat Regency. It was found that all indicator variables had validity, because they showed an r value of more than 0.375. In addition, all variables have reliability, because they show a Cronbach Alpha value above 0.73.

Furthermore, at the stage of the Hierarchical Analysis Process, calculations are carried out to obtain a pairwise comparison matrix, eigenvalue, eigenvector, maximum eigenvalue (λ), consistency index (CI), and consistency ratio (CR). By using the Microsoft Excel template designed by Klaus D. Goepel, the results were obtained:

Table 1. Pairwise comparison matrix

Variabel	X_1	X_2	X_3	X_4	X_5
X_1	1	2	1	7	2
X_2	1/3	1	2	2	6
X_3	1	¼	1	¼	0
X_4	0	¼	6	1	0
X_5	¼	1/3	7	7	1

Table 2. Priority Vector

Variable	X_1	X_2	X_3	X_4	X_5	Total	Priority Vector
X_1	0,387097	0,52174	0,058824	0,405797	0,222222	1,59568	0,319136
X_2	0,129031	0,26087	0,117647	0,115942	0,666667	1,290157	0,258031
X_3	0,387097	0,065217	0,058824	0,014493	0	0,525631	0,105126
X_4	0	0,065217	0,352941	0,057971	0	0,47613	0,095226
X_5	0,096774	0,086956	0,411765	0,405797	0,111111	1,112403	0,222481

The following are the respective values of the vector sum of weights, priority weights, λ, CI, and CR : $\begin{pmatrix} 2{,}051867 \\ 2{,}099997 \\ 0{,}512576 \\ 0{,}790491 \\ 1{,}790739 \end{pmatrix}$, $(6{,}429447 \quad 8{,}138534 \quad 4{,}87582 \quad 8{,}301216 \quad 8{,}048968)$, $\lambda = 7{,}518797$.

CI = 0,539699, CR = 0,0481874.

From the above results, it can be seen that the pairwise comparison matrix is consistent because the value of CR=0.0481874≤10%. The same thing was done to the other 99 respondents in order to find the consistency of the pairwise comparison matrix between each variable.

Then the fuzzy AHP method is used. In the initial stage, it is necessary to compare alternative features and their respective weights. To achieve this, it is necessary to use linguistic terms in addition to appropriate fuzzy numbers that indicate the magnitude of the comparison. By carefully following the prescribed procedure and performing the necessary calculations of the FAHP (Fuzzy Analytic Hierarchy Process) technique, the ranking strategy is obtained as follows.

Table 3. Accuracy Results of Determining Factors Affecting Student Learning Achievement

Factor	Average	Rank
X_1	0,50412	1
X_2	0,37144	3
X_3	0,1221	4
X_4	0,0431	5
X_5	0,4721	2

From table 3, it can be seen that the highest value is in factor X_1 with a value of 0.50412 compared to other factors.

4. CONCLUSION

Fuzzy Analytic Hierarchy Process (AHP) applications can be used in determining factors that influence student achievement, especially when there are several variables and many respondents involved. This approach facilitates the identification of the most appropriate decision by ascertaining the priority weight given to each criterion.

This study identifies physical influence as the main determinant for public junior high school students in Sei Bingai sub-district in their learning achievement. The application of the Fuzzy Analytic Hierarchy Process (AHP) data analysis technique revealed that the environmental element showed the largest average compared to other factors

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