

ANALYSIS OF STUDENT ACADEMIC ACHIEVEMENT LEVELS USING FUZZY LOGIC

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Abstrak

Penelitian ini bertujuan untuk menganalisa dan mendapatkan data tentang tingkat prestasi siswa menggunakan logika fuzzy yang nantinya digunakan untuk mempermudah menganalisa nilai-nilai siswa pada SMP Negeri 5 Batusangkar, logika fuzzy yang digunakan dalam penelitian ini adalah logika fuzzy model database Tahani. Data pada penelitian didapatkan dengan observasi, study literatur dari berbagai sumber. Diharapkan hasil analisis penelitian ini dapat membantu para guru dalam melakukan analisa nilai siswa tanpa harus melakukan pencarian secara manual, tetapi cukup melakukan nya dengan menggunakan media yang telah disediakan seperti microsoft excell, access, dan lain-lain sehingga pengolahan nilai dapat dilakukan dengan cepat, tepat dan menghasilkan data yang akurat. Dalam menentukan karakteristik tingkat prestasi akademik siswa tersebut, didasarkan pada Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi (Permendikbudristek) no. 21 Tahun 2022 tentang Standar Penilaian Pendidikan, Untuk menganalisa tingkat prestasi akademik siswa dilakukan dengan menggunakan logika fuzzy database tahani dengan cara memetakan nilai siswa berdasarkan Variable :Etika Pemanfaatan, Pengetahuan Informasi, Apektif (sikap). Pengujian teknik ini dilakukan dengan menggunakan microsoft excel dengan cara mengquerikan data-data yang telah dirancang.

Kata Kunci: Logika Fuzzy; Tahani; Nilai Siswa; Prestasi Akademik.

Abstract

The purpose of this study is to use fuzzy logic to analyze and retrieve data about student performance levels. This data will later be used to facilitate the analysis of the performance of SMP Negeri 5 Batusangkar students. Data for this study were obtained through observation and literature review from a variety of sources. The results of this survey analysis make it easier for teachers to analyze student performance without manual searches, and the ability to quickly process values using the provided media such as Microsoft Excel, Access, etc. We provide accurate and accurate data. When judging the characteristics of a student's level of academic performance, she complies with the Order of the Minister of Education, Culture, Research and Technology (Permendikbudristok) No. 21 of 2022 on Educational Evaluation Standards. Analyzing student performance levels is performed using a fuzzy logic database by mapping student results based on variables. Ethics of use, knowledge and aspects of information (attitudes). This technique is tested using Microsoft Excel to query the designed data.

Keyword: Fuzzy Logic; Tahani; Student Scores; Academic Achievement.

1. Introduction

The first inventor of the theory of fuzzy logic was Lotfi A. Zadeh. He came from the University of California at Berkeley in 1965 and wrote a paper containing the theory of fuzzy sets, where the theory was used and designed to create "smart machines." At that time, Lotfi A. Zadeh started a new series of machines that led to aspects of supporting the development of intelligent consumer products and systems [1]. The fuzzy logic system has four basic elements, including:

- 1) The rule base (basic rules), where there are rules sourced from experts in certain scientific fields.
- 2) Inference Engine (Decision Making Machine), a system that takes or draws conclusions or decisions by demonstrating the methods of experts in various fields of science to make a decision based on knowledge.
- 3) Fuzzification (Fuzzification Process), the process of changing fixed sets or crisps into fuzzy sets.
- 4) Defuzzification (defuzzification process), a process that changes the fuzzy quantities generated by the decision engine into a certain quantity [2].

The word "accomplishment" in KBBI means the result obtained (from what has been worked on and done). Achievements that we know in everyday life include:

- 1) Achievement in the academic field: the results obtained from learning activities in formal educational institutions, both schools and campuses, which are cognitive in the form of measurements and assessments of the processes that have been undertaken.
- 2) Learning achievement, or competencies possessed in the field of knowledge and skills contained in a subject, are usually represented in the form of numerical test scores given by the teacher to students.
- 3) Work Achievement: the achievement of an employee's performance in carrying out the tasks given and assigned to him.

From the results of field observations at SMP Negeri 5 Batusangkar, Tanah Datar Regency, it is found that teachers still need a long time to manage student scores because they need to determine the level of academic achievement obtained by their students. Based on this, it is necessary to have an application using fuzzy logic in analyzing student scores, which is useful for teachers in solving problems encountered in the process of assessing student academic achievement, so that the assessment can be carried out in a relatively short time and produce precise and accurate assessments.

2. Methods

2.1. Research Framework

In the research methodology there is a framework that will be carried out, the stages of the framework are an overview of the step by step that will be carried out so that the research can run well in accordance with the objectives. The following is a research framework:

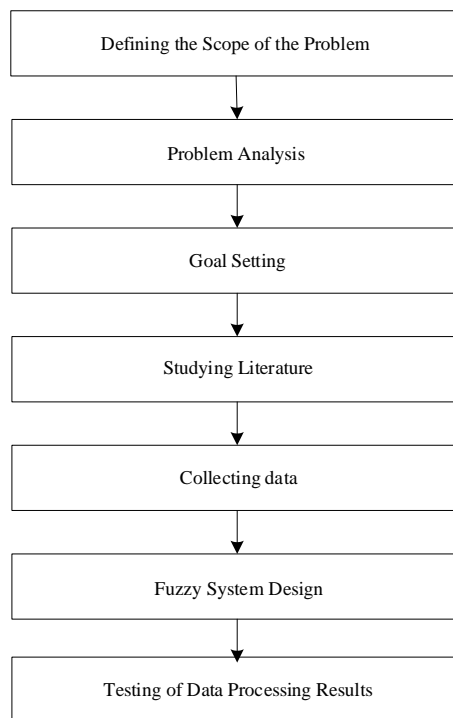


Figure 1. Research Framework

Based on this framework, each step can be explained as follows:

- 1) **Defining the Problem** The scope of the problem to be studied must be determined in advance; if the boundaries of the problem to be studied have not been determined and defined, then no solution can be found for the problem.
- 2) **Problem analysis** At this stage, an analysis is carried out regarding the problems studied. After the analysis of the problem has been completed, the root cause of the problem can be understood correctly and precisely. The analysis carried out includes:
 - a. an analysis of the various criteria that become Parameters in student assessment.
 - b. Analysis of student academic achievement.
 - c. Evaluation of existing priority options based on predefined criteria.
 - d. Fuzzy logic algorithms are used in the process of determining student academic achievement decisions.
- 3) **Setting Goals**

This study focuses on determining decision priorities in determining student scores based on the targeted goals, as well as criteria and alternatives from the available options. The final focus of this research is to apply:

 - a. A system design that contains the Parameters used in the fuzzy algorithm.
 - b. There is an analysis of student academic achievement by creating a simple hierarchy in decision-making.
- 4) **Studying Literature**

To achieve this goal, one then studies the literature that is most likely to be used. The literature is then chosen to determine which literature will be used in this study. Literature sources were obtained from libraries, books on fuzzy logic, and internet journals.
- 5) **Collecting Data**

The collection of information needs is done through observation, i.e., direct observation at predetermined research locations. It is hoped that problems in the field can be identified accurately and in detail. The method used in the data collection stage:

- a. Field observations are used to determine Parameters used in determining student academic achievement. This is used to get direct information from problems in the field so that it can be implemented with fuzzy logic.
 - b. Libretary Research is to collect information and theories related to the research that will be carried out.
 - c. Laboratory Research. Use laboratory research to obtain more in-depth information and literature from experts.
- 6) Analyze Available Data
The purpose of this stage is to analyze and examine the techniques used in data processing and to form a simple hierarchy, namely: main goals or objectives, criteria, and alternatives.
- 7) Fuzzy Logic Design
Fuzzy logic design is done in several steps: The first is to define fuzzy variables. Once the fuzzy variables are defined, several attributes are needed to define the membership function. This step is done by calculating the degree of the membership function (μ). The data is calculated based on the membership function and the attributes contained in the fuzzy variable, which defines a fuzzy set by grouping things based on linguistic variables and is expressed in the general membership function U, like that. Membership of a value in a set is expressed in degrees of membership, where the value is between 0 and 1. A "fuzzy set" is basically the idea of extending the range of a characteristic function in such a way that the function contains real numbers in the range 0 and 1. Usually the member values indicate that the object is not only right or wrong. A value of 0 means wrong, a value of 1 means right, and there are still values between 0 and 1 [3].
- 8) Testing of Data Processing Results
When testing the correctness of the results of the fuzzy set design, this can be done by using a fuzzy logic database, the AHAN model. The test uses the Microsoft Excel application, namely the following stages: Grouping the existing data in the student scores table into tables with more detailed and detailed data, making tables for each variable, which is divided into predetermined Parameters, then entering the values, there is a table of student scores. Making a query based on variables and Parameters, the results of the query are then ranked using sorting, and from the results of the test, the student scores that have the highest and lowest scores are obtained, so that the academic achievement of each student is obtained.

2.2. Managing Data with Fuzzy Analysis

- 1) Fuzzification
 - a. Determine the variables used
This study uses three main input variables and one main output variable. Determine data to determine student academic achievement based on variables required for planning, as well as an analysis of when these variables or criteria must be met. In determining these variables based on Regulation No. 21 of 2022 of the Minister of Education, Culture, Research, and Technology (Permendikbudristek), The data taken is the result of an assessment of student learning, which will later be presented and analyzed in the form of a fuzzy method. To build fuzzy inferences, a universe of conversations is needed.

Table 1. The Universe of Conversations

Function	Variable Name	Notation	Universe of Conversation	Description
Input	Utilization Ethics	A	[0 - 100]	Utilization Ethics Value
	Information Knowledge	B	[0 - 100]	Information Knowledge Value
	Affective (attitude)	C	[0 - 100]	Affective (attitude) Value
Output	Academic Achievement	D	[0 - 100]	Academic Achievement Value

b. Form a fuzzy set.

A fuzzy set is a grouping of variables based on linguistic variables represented by the universal membership function U. Membership of a value in a set is expressed as the degree of membership, with a value between 0 and 1. Fuzzy sets are based on the idea of extending the range of the characteristic function to include real numbers between 0 and 1. The membership value indicates that the object is not simply true or false. A value of 0 means wrong, a value of 1 means right, and there are still values between true and false. [4] [5].

If it is a crisp set, there are only two possible membership values, namely 0 or 1. But in a fuzzy set, the membership value lies between 0 and 1. If x has a fuzzy membership value of $\mu_A[x]=0$, it means that x is not a member of set A, and if the fuzzy membership value of $\mu_A[x]=1$, it means that x is a member of set A. The fuzzy set has two attributes, namely, linguistic and numerical. There are some things that need to be known in order to understand fuzzy systems, namely: fuzzy variables, fuzzy sets, the universe of speech, and domains. Affective (attitude).

Table 2. Fuzzy Input Sets

Variable		Fuzzy Input Sets		Domain
Name	Notation	Name	Notation	
Utilization Ethics	A	Not enough	K	[0 – 55]
		Good	B	[40 – 75]
		Very good	AB	[55 – 100]
Information Knowledge	B	Not enough	K	[0 – 55]
		Good	B	[40 – 75]
		Very good	AB	[55 – 100]
Affective (attitude)	C	Bad	BR	[0 – 55]
		Good	B	[45 – 75]
		Very good	AB	[60 – 100]

Table 3. Fuzzy Output Sets

Variable		Fuzzy Input Sets		Domain
Name	Notation	Name	Notation	
Academic Achievement	D	Not pass	TL	[0 65]
		Graduated	L	[60 100]

c. Utilization Ethics

The decreasing linear membership function is used to represent small fuzzy sets, and the increasing linear membership degree function is used for large fuzzy sets, while the triangular membership degree function is used to represent normal fuzzy sets. [6] This range has numeric data values; the lowest usage score is 0, while the highest score is 100. Here's the equation:

$$\mu \text{ Not enough } [x] = \begin{cases} 1; & x \leq 30 \\ (55-x) / (55-30); & 30 \leq x \leq 55 \\ 0; & x \geq 55 \end{cases}$$

$$\mu \text{ Good } [x] = \begin{cases} 1; & x \leq 40 \text{ or } x \geq 75 \\ (x-40) / (55-40); & 40 \leq x \leq 55 \\ (75-x) / (75-55); & 55 \leq x \leq 75 \\ 0; & \end{cases}$$

$$\mu \text{ Very Good } [x] = \begin{cases} 0; & x \leq 55 \\ (x-55) / (80-50); & 55 \leq x \leq 80 \\ 1; & x \geq 80 \end{cases}$$

From this equation, the form of the fuzzy membership function is illustrated, for example, in Table 4. The first input, according to the fuzzy analysis regarding the determination of the ethical value of utilization, whose data is still vague, is the basis for decision-making for the ethical value of utilization of student scores.

Table 4: Fuzzy Set for Use Ethics - Input

Fuzzy Variable Name	MF Model	Parameter	Range
Not Enough	trapmf	[0 30 55]	0 – 55
Good	trimf	[40 55 75]	40 – 75
Very Good	trapmf	[55 80 100]	55 – 100

Each variable has a range of values, which means that each ethical utilization value can be used in determining the ethical utilization value. The form of representation can be seen in Figure 2. The membership degree function of the utilization ethics variable is defined as follows:

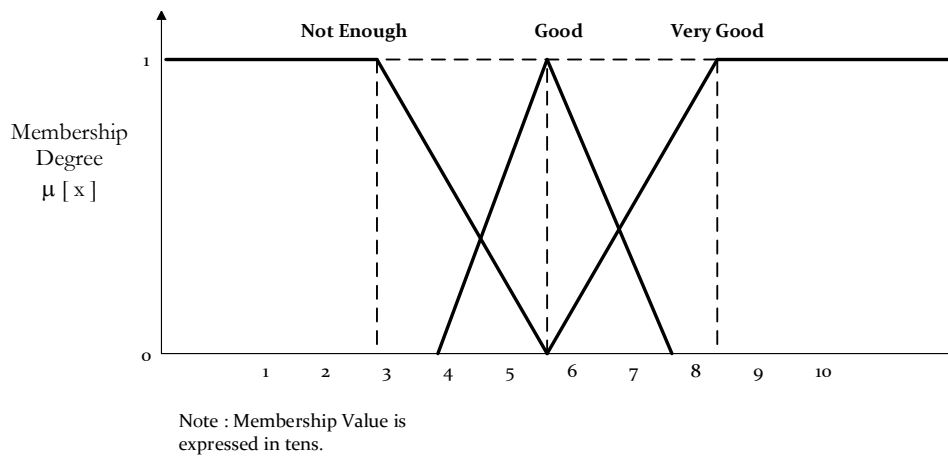


Figure 2. The Membership Degree Function of the Utilization Ethics Variable

From the equation and representation of the utilization ethics variable, it can be calculated by taking one of the utilization ethics values. If the ethical value of utilization is 50, then the fuzzy membership value of each set is:

- Fuzzy sets are Not Enough, $\mu_{\text{Not Enough}}[50] = 0,2$
 Obtained from:

$$= (55 - 50) / (55 - 30)$$

$$= 5/25$$

$$= 0,2$$
- Fuzzy sets are Good, $\mu_{\text{Good}}[50] = 0,6$
 Obtained from:

$$= (50 - 40) / (55 - 40)$$

$$= 10 / 15$$

$$= 0.6$$
- Fuzzy sets are Very good, $\mu_{\text{Very Good}}[50] = 0,0$

The bad and good classifications contain a value of 50, so the result is 0. From the data above, we obtained the form of the Tahani model with a fuzzy database:

Table 5. Database Model of Ethical Utilization Variable Resistance

No	Name	KKM	Utilization Ethics	Membership Degree (μ)		
				Not Enough	Good	Very Good
99	xxxxxx	99	50	0,2	0,6	0

From the table model of the variable ethics of utilization described above, it can be concluded that a value of 50 belongs to the good Parameter.

d. Variable Information Knowledge

The decreasing linear membership degree function is used to represent small fuzzy sets and the increasing linear membership degree function for large fuzzy sets, while the triangular membership degree function is used to represent normal fuzzy sets. For the range shown in the numeric value data, the small data value is 0, while the maximum value is 100. This can be seen from the equation below.

$$\mu \text{ Not Enough } [y] = \begin{cases} 1; & x \leq 30 \\ (55-x) / (55-30); & 30 \leq x \leq 55 \\ 0; & x \geq 55 \end{cases}$$

$$\mu \text{ Good } [y] = \begin{cases} 1; & x \leq 40 \text{ atau } x \geq 75 \\ (x-40) / (55-40); & 40 \leq x \leq 55 \\ (75-x) / (75-55); & 55 \leq x \leq 75 \\ 0; & \end{cases}$$

$$\mu \text{ Very Good } [y] = \begin{cases} 0; & x \leq 55 \\ (x-55) / (80-55); & 55 \leq x \leq 80 \\ 1; & x \geq 80 \end{cases}$$

From this equation, the form of the fuzzy membership function is as shown in Table 6. The first fuzzy analysis input is about determining the value of informational knowledge, the data for which is still ambiguous as a basis for decision-making about the value of informational knowledge based on student scores.

Table 6: Information and Knowledge Fuzzy Sets for Input

Fuzzy Variable Name	MF Model	Parameter	Range
Not Enough	Trapmf	[0 30 55]	0 – 55
Good	Trimf	[40 55 75]	40 – 75
Very Good	Trapmf	[55 80 100]	55 – 100

The form of representation is shown in Figure 3. The membership degree function of the information knowledge variable is defined as follows:

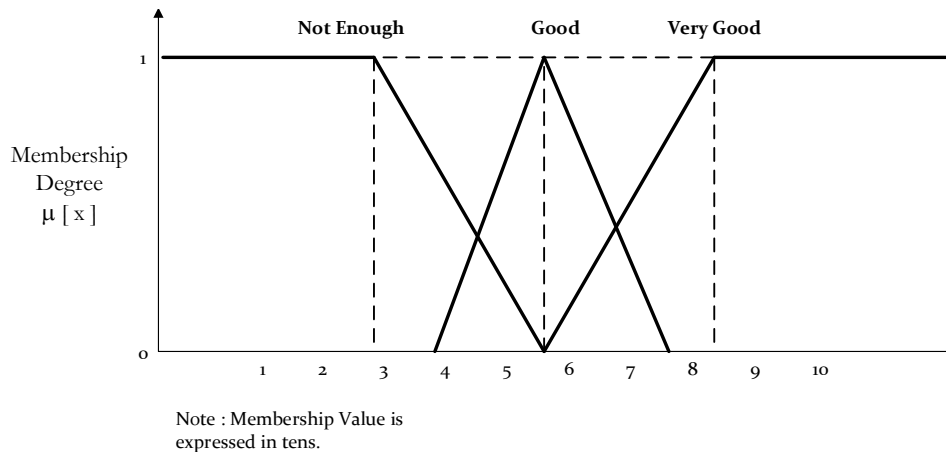


Figure 3: Information Knowledge Variable Membership Degree Function

From the equation and representation of the information knowledge variable above, it can be calculated by taking one of the information knowledge values, for example: If the ethical value of utilization is 65, then the fuzzy membership value in each set is:

- a. Fuzzy Set Not Enough, $\mu_{\text{Not Enough}} [65] = 0,0$
The value of 65 is included in the good classification, so the result obtained is 0.
- b. Fuzzy Set Good, $\mu_{\text{good}}[65] = 0,5$
Obtained from:

$$= (75 - 65) / (75 - 55)$$

$$= 10 / 20$$

$$= 0.5$$
- c. Fuzzy Set Very Good, $\mu_{\text{Very Good}} [65] = 0,4$
Obtained from:

$$= (65 - 55) / (80 - 55)$$

$$= 10 / 25$$

$$= 0.4$$

We can derive the shape of the fuzzy database Tahani model with resistance from the set above:

Table 7. Data Knowledge Variable Tahani Database Model

No	Name	KKM	Information Knowledge	Membership Degree (y)		
				Not Enough	Good	Very Good
99	xxxxxx	99	65	0	0,5	0,4

From the table of the Tahani model to hold the information knowledge variable above, it can be concluded: a value of 65 belongs to the good Parameter.

e. Affective Variable (Attitude)

The decreasing linear membership degree function is used to represent low fuzzy sets and the increasing linear membership degree function for high fuzzy sets, while the triangular membership degree function is used to represent normal fuzzy sets. For the range seen in the values of the data numbers, the low value for affective (attitude) is 0, while the highest value is 100. This can be seen from the equation below.

$$\mu_{\text{Bad}} [z] = \begin{cases} 1; & x \leq 40 \\ (40 - x) / (65 - 40); & 40 \leq x \leq 65 \\ 0; & x \geq 65 \end{cases}$$

$$\mu_{\text{Good}} [z] = \begin{cases} 1; & x \leq 45 \text{ atau } x \geq 75 \\ (x - 45) / (60 - 45); & 45 \leq x \leq 60 \\ (75 - x) / (75 - 60); & 60 \leq x \leq 75 \\ 0; & \end{cases}$$

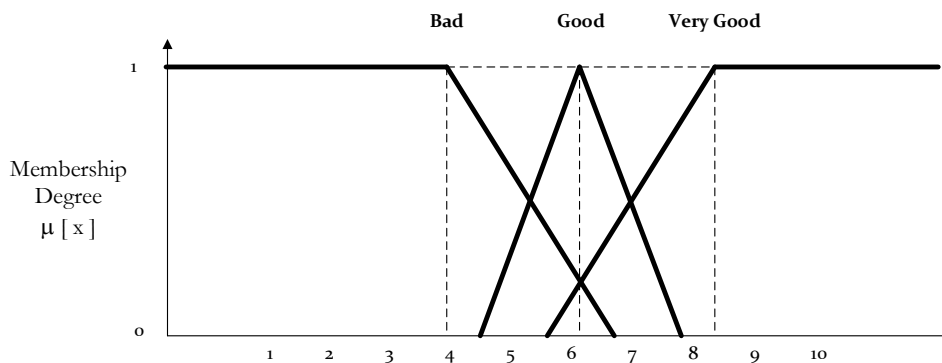
$$\mu_{\text{Very Good}} [z] = \begin{cases} 0; & x \leq 55 \\ = (x - 55) / (80 - 55); & 55 \leq x \leq 80 \\ 1; & x \geq 80 \end{cases}$$

From this equation, the form of the fuzzy membership function is described in Table 8. The first input from the fuzzy analysis is about determining affective (attitude) values whose data are still vague as a basis for making decisions about the value of informational knowledge from student scores.

Table 8. Affective Fuzzy Sets (Attitudes) for Input

Fuzzy Variable Name	Model MF	Parameter	Range
Not Enough	Trapmf	[0 40 65]	0 – 65
Good	Trimf	[45 60 75]	45 – 75
Very Good	Trapmf	[55 80 100]	55 – 100

The form of its representation can be seen in Figure 4. The membership degree function of the affective variable (attitude) is defined as follows:



Note : Membership Value is expressed in tens.

Figure 4. The Membership Degree Function of the Affective Variable (Attitude)

From the equations and representations of the affective variables above, it can be calculated by taking one of the affective values, for example: If the affective value is 70 then the fuzzy membership value in each set is:

- Fuzzy Set Bad, $\mu_{\text{Bad}} [70] = 0,0$
The value of 70 is included in the very good classification, so the result obtained is 0.
- Fuzzy Set Good, $\mu_{\text{Good}} [70] = 0,0$
The value of 70 is included in the very good classification, so the result obtained is 0.
- Fuzzy Set Very Good, $\mu_{\text{Very Good}} [70] = 0,6$
Obtained from:

$$= (70 - 55) / (80 - 55)$$

$$= 15 / 25$$

$$= 0.6$$

We can derive the shape of the fuzzy database model with resistance from the set above:

Table 9. Database Tahani Model of Affective Variables (attitudes)

No	Name	KKM	Affective (attitudes)	Membership Degree ([z])		
				Bad	Good	Very Good
99	xxxxxx	99	70	0	0	0,6

From the table of the affective variable resistance model above, it can be concluded that a value of 70 belongs to the very good Parameter.

f. Academic Achievement Variable

The decreasing linear membership degree function is used to represent low-dimensional fuzzy sets, and the increasing linear membership degree function is used to represent high-dimensional fuzzy sets. For the range seen in the values of the data numbers, the low score on academic achievement is 0, while the highest score is 100. This can be seen from the equation below.

$$\begin{aligned} \mu \text{ Not Graduated [a]} &= \begin{cases} 1; & x \leq 50 \\ (50 - x) / (65 - 50); & 50 \leq x \leq 65 \\ 0; & x \geq 65 \end{cases} \\ \mu \text{ Graduated [a]} &= \begin{cases} 0; & x \leq 60 \\ (x - 60) / (80 - 60); & 60 \leq x \leq 80 \\ 1; & x \geq 80 \end{cases} \end{aligned}$$

Table 10 details the fuzzy sets for the output of the fuzzy analysis of academic achievement based on the values of ethical utilization, information knowledge, and aspects whose data are still vague as a basis for decision-making to determine student academic achievement.

Table 10. Fuzzy Set of Academic Achievements for Output

Fuzzy Variable Name	Model MF	Parameter	Range
Graduated	Trapmf	[0 55 65]	0 – 65
Not Graduated	Trapmf	[60 80 100]	60 – 100

Each variable has a value range, which means that each value represents knowledge of information that is useful in determining the value of information knowledge. The form of its representation is shown in Figure 5. The membership degree function of the academic achievement variable is defined as follows:

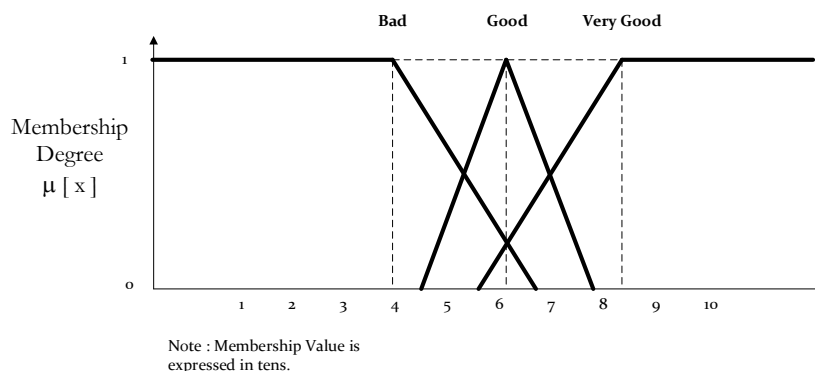


Figure 5. Representative Degree of Membership Function from the Academic Achievement

Variable From the equation and representation of academic achievement, it can be calculated by taking the results from the ethical values of utilization, information processing, and aspects that have been combined and divided into 3, for example: If the results of combining the ethical values

of utilization, information processing, and affectiveness are divided by three, they equal 70, and the fuzzy membership value in each set is explained as follows:

- a. Fuzzy Set Not Graduated, $\mu_{\text{Not Graduated}} [70] = 0,0$
The value of 70 is included in the very good classification, so the result obtained is 0.
- b. Fuzzy Set Not Graduated, $\mu_{\text{Graduated}} [70] = 0.5$
Obtained from :

$$= (70 - 60) / (80 - 60)$$

$$= 10 / 20$$

$$= 0.5$$

We can derive the shape of the fuzzy database model with resistance from the set above:

Table 11. shows that the database model excludes academic achievement variables

No	Name	KKM	Academic Achievement	Membership Degree ([a])	
				Not Graduated	Graduated
99	xxxxxx	99	70	0	0,5

From the table, it can be concluded that the results of the academic achievement variable, which is a combination of the ethical values of utilization, information processing, and affectiveness and divided by 3 to equal 70, belong to the pass Parameter. As a result, when the data on the academic achievement variable is sorted, the names of students who successfully graduate and receive accomplishments are obtained.

2.3. Reasoning (Inference)

At this point, the fuzzy logic system's rules have been determined, and these rules can be used to represent input/output relationships. Every rule has an implication. The operator that is utilized in connecting input rules is the AND operator, while the one in charge of representing the input/output is IF/THEN. The rules are obtained from the available data. The greater the amount of data obtained, the more rules will appear. The more rules used, the better the analysis obtained [7, 8]. Of the three fuzzy inputs, the rules that will be used are determined. The rules that will be determined are based on the values of three inputs, namely: utilization ethics, informational knowledge, and affectivity, and one output in the form of student academic achievement.

3. Result and Discussion

3.1. Testing Results of Analysis and Design

1) Student Grade Data

This student score data is the original data, which will be further divided into a more complete table. This student score data is obtained from the results of a one-semester learning assessment that has been processed and grouped into 3 variables. This student value data is contained in the raw data table listing student scores (table 12).

Table 12. Raw Data Table of Student Grades

NO	NAME	KKM	EVALUATION				Academic Achievement
			Utilization Ethics	Information Knowledge	Affective (Attitude)		
					Value	Grade	
1	Anim Saputra	65	75	65	60	C	Graduated
2	Edi Santoso	65	77	80	55	C	Graduated
3	Giantara	65	45	60	50	C	Not Graduated

4	Hermanto	65	67	71	54	C	Not Graduated
5	Hardiyanto	65	70	58	60	C	Not Graduated
6	Nur Wahid	65	75	85	60	C	Graduated
7	Obi Rio	65	64	69	70	B	Graduated
8	Riki Irawan	65	93	74	85	A	Graduated
9	Suryanto	65	70	70	70	B	Graduated
10	Wani Elfianis	65	76	68	85	A	Graduated
11	Wowon	65	70	87	80	A	Graduated
12	Atik Setiani	65	80	65	73	B	Graduated
13	Dila Rosina	65	66	80	75	B	Graduated
14	Jumartina	65	80	70	90	A	Graduated
15	Mustika	65	65	56	85	A	Graduated
16	Nurul Wina	65	70	80	70	B	Graduated
17	Nopi Laila	65	70	88	88	A	Graduated
18	Retni	65	60	70	70	B	Graduated
19	Sheila	65	49	79	60	C	Not Graduated
20	Yuli Indah	65	85	75	90	A	Graduated

Then, from the raw data table, a list of student values was processed into a temporary data table to calculate the ethics of utilization, information knowledge, affective learning, and academic achievement (based on the table list of student values).

Table 13. Table of Student Values

NO	NAME	KKM	EVALUATION			Academic Achievement
			Utilization Ethics	Information Knowledge	Affective (Attitude) Value Grade	
1	ANIM SAPUTRA	65	75	65	60 C	66.7
2	EDI SANTOSO	65	77	68	55 C	66.7
3	Giantara	65	45	60	54 C	53.0
4	HERMANTO	65	67	71	50 C	62.7
5	HARDIYANTO	65	70	58	60 C	62.7
6	NURWAHID	65	75	85	60 C	73.3
7	OBIRIO	65	64	69	70 B	67.7
8	RIKI IRAWAN	65	93	74	80 A	82.3
9	SURYANTO	65	70	70	75 B	71.7
10	WANI ELFIANIS	65	76	68	85 A	76.3
11	WOWON	65	70	87	80 A	79.0
12	ATIK SETIANI	65	80	65	73 B	72.7
13	DILA ROSINA	65	66	80	75 B	73.7
14	JUMARTINA	65	80	70	90 A	80.0
15	MUSTIKA	65	65	56	85 A	68.7
16	NURUL WINA	65	70	80	70 B	73.3
17	NOPI LAILA	65	70	88	88 A	82.0
18	RETNi	65	60	70	70 B	66.7
19	SHEILA	65	49	79	60 C	62.7
20	YULI INDAH	65	85	75	90 A	83.3

From the student score list table above, we divide it into several membership tables, each consisting of its respective members, namely:

1) Student Grades Based on Use Ethics

The value of students based on the ethics of utilization is a grouping of variables and parameters, with one variable and three parameters. The processed value is the value obtained from the original data based on the previously planned design.

Table 14. Table of Student Values Based on Utilization Ethics

NO	NAME	UTILIZATION ETHICS	MEMBERSHIP DEGREE ([x])		
			VERY GOOD	GOOD	NOT ENOUGH
1	ANIM SAPUTRA	75	0.8	0	0
2	EDI SANTOSO	77	0.88	0	0
3	GANTARA	45	0	1	0.4
4	HERMANTO	67	0.48	0.4	0
5	HARDIYANTO	70	0.6	0.25	0
6	NURWAHID	75	0.8	0	0
7	OBIRIO	64	0.36	0.55	0
8	RIKI IRAWAN	93	1	0	0
9	SURYANTO	70	0.6	0.25	0
10	WANI ELFIANIS	76	0.84	0	0
11	WOWON	70	0.6	0.25	0
12	ATIK SETIANI	80	1	0	0
13	DILA ROSINA	66	0.44	0.45	0
14	JUMARTINA	80	1	0	0
15	MUSTIKA	65	0.4	0.5	0
16	NURUL WINA	70	0.6	0.25	0
17	NOPI LAILA	70	0.6	0.25	0
18	RETNI	60	0.2	0.75	0
19	SHEILA	49	0	1	0.24
20	YULI INDAH	85	1	0	0

The table shows that the most dominant parameter is a very good parameter because the existing data on the variable utilization ethics has a high value.

2) Student value based on information Knowledge

Student scores based on this informational knowledge are a grouping of variables and parameters, with one variable and three parameters. The processed value is the value taken from the original data based on the design that has been made.

Table 15. Table of Student Values Based on Information and Knowledge

NO	NAME	INFORMATION KNOWLEDGE	MEMBERSHIP DEGREE ([y])		
			VERY GOOD	GOOD	NOT ENOUGH
1	ANIM SAPUTRA	65	0.4	0.5	0
2	EDI SANTOSO	68	0.52	0.35	0
3	GANTARA	60	0.2	0.75	0
4	HERMANTO	71	0.64	0.2	0
5	HARDIYANTO	58	0.12	0.85	0
6	NURWAHID	85	1	0	0
7	OBIRIO	69	0.56	0.3	0

8	RIKI IRAWAN	74	0.76	0.05	0
9	SURYANTO	70	0.6	0.25	0
10	WANI ELFIANIS	68	0.52	0.35	0
11	WOWON	87	1	1	0
12	ATIK SETIANI	65	0.4	0.5	0
13	DILA ROSINA	80	1	0	0
14	JUMARTINA	70	0.6	0.25	0
15	MUSTIKA	56	0.04	0.95	0
16	NURUL WINA	80	1	1	0
17	NOPI LAILA	88	1	1	0
18	RETNI	70	0.6	0.25	0
19	SHEILA	79	0.96	1	0
20	YULI INDAH	75	0.8	0	0

The table shows that the most dominant parameter is the very good parameter, because the data on the information knowledge variable has a lot of high value.

3) Student Values Based on Appeal (Attitude)

In this affective aspect, student scores are a grouping of variables and parameters with one variable and three parameters. In accordance with the previously made plans.

Table 16. Table of Student Values Based on Aspects (Attitudes)

NO	NAME	AFFECTIVE (ATTITUDE)	MEMBERSHIP DEGREE (z)		
			VERY GOOD	GOOD	NOT ENOUGH
1	ANIM SAPUTRA	60	0.2	1	0
2	EDI SANTOSO	55	0	1	0
3	GANTARA	54	0	1	0
4	HERMANTO	50	0	1	0
5	HARDIYANTO	60	0.2	1	0
6	NURWAHID	60	0.2	1	0
7	OBIRIO	70	0.6	0.33	0
8	RIKI IRAWAN	80	1	0	0
9	SURYANTO	75	0.8	0	0
10	WANI ELFIANIS	85	1	0	0
11	WOWON	80	1	0	0
12	ATIK SETIANI	73	0.72	0.13	0
13	DILA ROSINA	75	0.8	0	0
14	JUMARTINA	90	1	0	0
15	MUSTIKA	85	1	0	0
16	NURUL WINA	70	0.6	0.33	0
17	NOPI LAILA	88	1	0	0
18	RETNI	70	0.6	0.33	0
19	SHEILA	60	0.2	1	0
20	YULI INDAH	90	1	0	0

This table shows that the most dominant parameter is the good parameter because the data on the affective variable has a moderate value.

4) Student Score Based on Academic Achievement

Academic achievement scores are a combination of the three previous variables. We can see the form of this variable in the table of student scores based on informational knowledge.

Table 17. Table of Student Scores Based on Academic Achievement

NO	NAME	ACADEMIC ACHIEVEMENT	MEMBERSHIP DEGREE ([a])	
			NOT GRADUATED	GRADUATED
1	ANIM SAPUTRA	50	1	0
2	EDI SANTOSO	70	0	1
3	GANTARA	65	0	0
4	HERMANTO	55	0.7	0
5	HARDIYANTO	70	0	1
6	NURWAHID	65	0	0
7	OBIRIO	30	1	0
8	RIKI IRAWAN	67	0	0
9	SURYANTO	70	0	1
10	WANI ELFIANIS	76	0	1
11	WOWON	80	0	1
12	ATIK SETIAWANI	80	0	1
13	DILA ROSINA	90	0	1
14	JUMARTINA	80	0	1
15	MUSTIKA	65	0	0
16	NURUL WINA	65	0	0
17	NOPI LAILA	70	0	1
18	RETNI	85	0	1
19	SHEILA	75	0	1
20	YULI INDAH	85	0	1

The table shows that the most dominant parameter is the pass parameter because the existing data on the academic achievement variable is the result of a combination of the ethical utilization, information knowledge, and affective variables, which have a higher value, so that the student graduation rate is more dominant and to determine achievement. We can sort this student's data based on the pass parameter with a higher value.

5) Queries

The method that can be used to access records from one or more tables that have attributes that match the current criteria is called a query. There are various methods for using queries, such as using Microsoft queries, Microsoft Access, or SQL (Structure Query Language) statements. In Microsoft Access, a query is a tool used to find and select fields and records from a specific table or, more generally, from a query that has a relationship with a specific set of criteria. Using queries in database applications is a data manipulation process designed to make results more timely, accurate, and easy to use.

a. Queries1

Which students have the ethical values of excellent utilization and good use of information?

```
SELECT NAME
```

```
FROM STUDENT SCORES
```

```
WHERE (Utilization Ethics = "VERY GOOD") and (INFORMATIONAL KNOWLEDGE = "Good")
```

b. Query2

Which students have the ethical value of very good use or good use of information?

- SELECT NAME
FROM STUDENT SCORES
WHERE (Utilization Ethics = "VERY GOOD") or (Information Knowledge = "BAD")
- c. Query3
Which students have good utilization of ethical values and bad affective values?
SELECT NAME
FROM STUDENT SCORES
WHERE (Utilization Ethics = "GOOD") and (Affective = "BAD")
- d. Query4
Which students have good utilization of ethical values or bad affective values?
SELECT NAME
FROM STUDENT SCORES
WHERE (Utilization Ethics = "GOOD") or (Affective = "BAD")
- e. Query5
Which students have very good ethical utilization values and good information utilization values, based on their graduate academic achievement?
SELECT NAME
FROM STUDENT SCORES
WHERE [(Utilization Ethics = "GOOD") and (Affective = "BAD")] and (Academic Achievement = "GRADUATED")
- f. Query6
Which students have very good ethical utilization values and good information utilization values, based on their graduate academic achievement?
SELECT NAME
FROM STUDENT SCORES
WHERE [(Utilization Ethics = "GOOD") and (Affective = "BAD")] or (Academic Achievement = "GRADUATED")
- g. Query7
Which students have very good utilization ethical values, good information utilization values, good utilization ethical values, bad affective values, and graduated academic achievement?
SELECT NAME
FROM STUDENT SCORES
WHERE {[(Utilization Ethics = "VERY GOOD") and (Information Utilization = "GOOD")] and [(Utilization Ethics = GOOD") and (Apective = BAD)]} and (Academic Achievement = "NOT GRADUATED ")
- h. Query8
Which students have very good utilization ethical values, good information utilization values, good utilization ethical values, bad affective values, and graduated academic achievement?
SELECT NAME
FROM STUDENT SCORES
WHERE {[(Utilization Ethics = "VERY GOOD") and (Information Utilization = "GOOD")] and [(Utilization Ethics = GOOD") and (Apical = BAD)]} or (Academic Achievement = "NOT GRADUATED")

The query results can be grouped using a query to see or determine which students excel based on the variables and parameters that have been processed.

4. Conclusion

After conducting an analysis of the level of academic achievement using the fuzzy logic database, it can be concluded that: "In determining the characteristics of the level of academic

achievement of these students, it is based on the Regulation of the Minister of Education, Culture, Research, and Technology (Permendikbudristek) No. 21 of 2022 concerning Educational Assessment Standards." To analyze the level of student achievement, it is carried out using fuzzy logic databases by mapping student scores based on variables: ethics of utilization, knowledge of information, and aspects (attitudes).

Testing this technique is done by using Microsoft Excel and querying the data that has been designed. In completing the final stage of this research, there are still many deficiencies that must be corrected and fulfilled, including the following: this test can later also be carried out using other applications, such as Microsoft Access, MySQL, Oracle, and other database applications. The applications used are still simple. In the future, this research can be further developed into more complex and better research and implemented across all schools.

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