

## Early Detection Level to Students Anxiety Using Fuzzy Sugeno Method

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### Abstract

*Anxiety disorders are generally common, especially in adolescents. In institutions that provide non-formal education such as Learning activity group or Sanggar Kegiatan Belajar (SKB), students often face complex problems ranging from family problems, problems in teaching and learning activities and problems at work. For this reason, further treatment is needed to overcome the problems faced. One of them is counseling activities, this activity is really needed to help students find the right solution. However, the teaching staff, both tutors and teachers who teach, do not yet have the basic knowledge to handle proper counseling. The importance of carrying out this research activity is that it can help students, teachers and leaders in overcoming student anxiety disorders which have an impact on teaching and learning activities. Tools are really needed to detect students who has mild, moderate or severe anxiety disorders and students who do not have anxiety. The aim of this research is to provide recommendations for students' anxiety levels using the DASS-21 tools. In this tool there are questions for anxiety that students must answer, consisting of 7 questions. The method used in this research is Fuzzy Sugeno. The contribution to this research recommends a model for early detection of student anxiety using Fuzzy Sugeno so as to eliminate ambiguity and uncertainty in the answers to existing questions. The implication of this research is that the Fuzzy Sugeno method is suitable for early detection of student anxiety with a high accuracy rate of 66.67% so that students can detect early the level of mental anxiety early. With the results of recommendations for anxiety levels, teachers can handle students and provide solutions to students easier and leaders can be a supporter in decision making.*

**Keywords**—Anxiety; Fuzzy Sugeno ; Recommendation; DASS-21; Sanggar Kegiatan Belajar

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### 1. PENDAHULUAN

According to the World Health Organization, Health covers physical health, mental health, and social welfare in a balance condition [1]. People who have balanced mental health can solve their problems. Therefore, they can contribute to their surroundings [2]. In 2019, there were around 301 million people who suffered from anxiety disorder around the globe which number of woman is higher than man. Children and teenagers often suffer anxiety disorder. There are symptoms of anxiety disorders such as : Difficulty making decisions, difficulty concentrating, nervous, easily offended, nauseous, stomach ache, shivering, difficulty sleeping, and panic. People who suffer from anxiety disorder have a high potential risk

suffered depression, using drug abuse, and being willing to commit suicide [3]. One of the ways to solve anxiety disorder is strengthening educational institution including nonformal education. One of nonformal education is Sanggar kegiatan belajar (SKB) or Learning activity group. At SKB 26, Bintaro, South Jakarta, We found 20 out of 44 students detected anxiety disorder suffered in 2023. Their anxiety disorder affects their study activities. Moreover, they have other problems, such as problems with their family and learning activities. To solve their anxiety disorder problem, some activities need to be done, one of them is counseling activity. However, teachers who solve their problems need basic counseling knowledge. Therefore, they need tools and training to help teachers to solve their student's anxiety disorders. This

research is for recommending of anxiety disorder suffered by students using DASS-21 tool which provide seven questions for students. This research using Fuzzy Sugeno method which able to answer uncertainty and ambiguity in the answers from such seven questions. According to Elin, academic process could be anxiety caused at an intermediate level, in which female students have higher academic anxiety than male students [4]. Some of the causes of the anxiety disorders are smartphones and the internet, which affect students anxiety. This Fuzzy logic is needed to solve uncertainty in input and used for better model development [5]. This Fuzzy Sugeno method is used for identifying students' anxiety, therefore, able to improve schools' and teachers' efficiency and effectivity in early detection of students anxiety disorder [6]. In a company, the best employee performance is needed by a company. Therefore, to detect employee anxiety disorder, we need a model generator to detect anxiety disorder based on psychological data using the Fuzzy Sugeno method [7]. Another research discusses Psychology parameters thought of as ambiguity, therefore modeling with Fuzzy logic could explain ambiguity and uncertainty [7].

## 2. RESEARCH METHOD

Fuzzy logic is used in this research. Some steps using this method are as follows:

### 2.1. Data collection method

We used primary data in this research and made a question list DASS-21 for SKB 26 Bintaro, South Jakarta. We got secondary data from scientific journals, electronic media, and books. This research discusses students' anxiety disorders using the Fuzzy Sugeno Method.

### 2.2. Fuzzy inference system

The Fuzzy logic theory is applied to ambiguity and uncertainty [9]. Fuzzy logic can handle truth value and obtain truth value on any occasions. Fuzzy Inference System (FIS) is a rule-based system using Fuzzy logic, which in many real-life scenario uses clear or structured data as input for decision making system. Input or concept is available in Fuzzy as essential to the decision-making process. FIS discusses uncertainty and ambiguity in domain problems and effectively uses inference machines in decision-making. [10][11].

### 2.3. Fuzzy Sugeno

Fuzzy Takagi Sugeno Kang or Fuzzy Sugeno is a linear equation functional for

implementation in medical diagnosis and system development [12]. There are two orders as follows :

$$IF(x_1 is A_1) o (x_2 is A_2) o (x_3 is A_3) o \dots o ((x_N is A_N)) \\ THEN z = k \quad (1)$$

Remarks : A is fuzzy set on  $i^{th}$  as antecedent and k is a constant (firm) as consequent. Fuzzy Sugeno model Orde-one as follows :

$$IF(x_1 is A_1) o \dots o (x_N is A_N) THEN z \\ = p_1 * x_1 + \dots + p_N * x_N + q$$

Remarks :  $A_i$  is Fuzzy set to it as an antecedent,  $P_i$  is constant (firm), and q is continuous in consequence. There is also ANFIS with sample usage for classification measures. However, this research uses FIS [13].

### 2.4. Research step

We need some steps to obtain the research goal, as depicted in Figure 1.

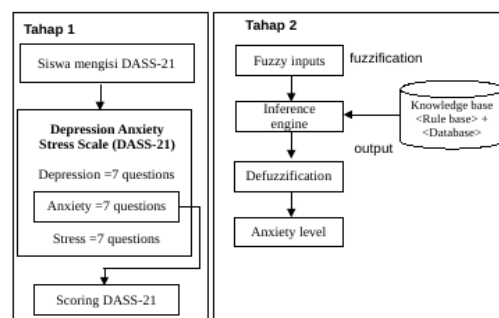


Figure 1 : Research steps

In Figure 1, in phase 1, SKB 26 students fill DASS 21 Questions list using Google form by giving scores manually follows DASS-21 calculation [14]. Then, students can choose appropriate answers to the actual conditions with a choice of answers as follows : 0 = Never, 1 = Sometimes, 2= fair – often, and 3 = Often. To calculate we sum all answer scores every student then multiply with 2 [15]. In phase 2, Fuzzy Logic Sugeno method is used in some steps as follows. Preparing input variable with seven questions about anxiety. Apply an Inference Engine with Rule-based to generate output as a recommendation of student anxiety level whether in normal conditions, light, mild, or heavy.

## 3. RESULT AND DISCUSSION

Result and discussion using Fuzzy Logic Sugeno with 7 variabel input as follows.

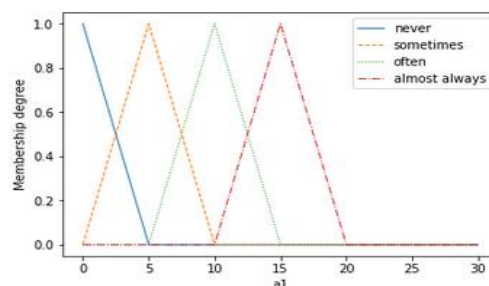
Code	Question	Fuzzy set	Notation
a1.	I was aware	Never	N

	of dryness of my mouth	Sometimes Often Almost Always	S O AA
a2.	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	Never Sometimes Often Almost Always	N S O AA
a3	I experienced trembling (eg, in the hands)	Never Sometimes Often Almost Always	N S O AA
a4	I was worried about situations in which I might panic and make a fool of myself.	Never Sometimes Often Almost Always	N S O AA
a5	I felt I was close to panic.	Never Sometimes Often Almost Always	N S O AA
a6	I was aware of the action of my heart in the absence of physical exertion.	Never Sometimes Often Almost Always	N S O AA
a7	I felt scared without any good reason.	Never Sometimes Often Almost Always	N S O AA

Table 1 : Input variables for anxiety

The list consists of seven (7) input variables; every student has to answer all questions honestly to determine his anxiety level. Every input variable is represented using a Fuzzy number as follows :N=(0, 0, 5), S=(0, 5, 10), O=(5, 10, 15), AA=(10, 15, 20) can be depicted for a chart of element function for every input variable as depicted in Figure 2 as follows.

Fig 2 : Element function chart for input variable of anxiety code a1



For the chart of element functions, a2 until a7 is the same as a1. Chart generation in Fig 2 used Python programming language with pseudocode as follows :

**Pseudocode 1:** chart of element function a1

**Output :** chart

```

1 from simpful import*
2 FS=FuzzySystem( )
3 c1=FuzzySet(function=Triangular_MF(a
  =0,b=0,c=5), term="tidak_pernah")
4. c2=FuzzySet(function=Triangular_MF(a
  =0,b=5,c=10),term="kadang_kadang")
5 c3=FuzzySet(function=Triangular_MF(a
  =5,b=10,c=15),term="cukup_serang")
6 c4=FuzzySet(function=Triangular_MF(a
  =10,b=15,c=20),term="serang")
7 LV1 = LinguisticVariable([c1,c2,c3,c4],
  concept="anxiety_a1",
  universe_of_discourse=[0,30])
8 FS.add_linguistic_variable("a1", LV1)
9 LV1.plot()

```

Table 2 : Pseudocode a1

For output variable which has 4 output is shown in table 3 as follows :

Notation	Anxiety level
N	Normal
M	Mild
Me	Medium
H	Heavy

Table 3. Output variables of anxiety level

In table 3, could be known output variable with anxiety recommendation levels that are normal, light, medium and heavy. In output variable is represented using Fuzzy number with

$N=(0,0,10)$ ,  $M=(0,10,20)$ ,  $Me=(10,20,30)$ ,  
 $H=(20,30,40)$  with rules as follows :

Rules	IF	IS	OR	IS	OR	IS	OR
R1	a1	KK	a2	TP	a3	TP	a4
R2	a1	TP	a2	TP	a3	TP	a4
R3	a1	KK	a2	CS	a3	KK	a4
R4	a1	TP	a2	TP	a3	TP	a4
R5	a1	KK	a2	KK	a3	KK	a4
R6	a1	TP	a2	KK	a3	KK	a4
R7	a1	KK	a2	KK	a3	KK	a4
R8	a1	TP	a2	TP	a3	KK	a4
R9	a1	TP	a2	KK	a3	TP	a4
R10	a1	KK	a2	KK	a3	SR	a4
R11	a1	TP	A2	KK	a3	KK	a4
R12	a1	KK	a2	TP	a3	KK	a4
R13	a1	KK	a2	KK	a3	SR	a4
R14	a1	TP	a2	TP	a3	TP	a4
R15	a1	KK	a2	TP	a3	KK	a4
Rn	a1	...	...	...	...	...	...

IS	OR	IS	O R	IS	OR	IS	Then Anxiety is
KK	a5	KK	a6	TP	a7	TP	normal
TP	a5	TP	a6	TP	a7	TP	normal
KK	a5	KK	a6	SR	a7	SR	medium
TP	a5	TP	a6	TP	a7	TP	normal
CS	a5	KK	a6	TP	a7	SR	medium
TP	a5	KK	a6	TP	a7	KK	normal
KK	a5	KK	a6	CS	a7	TP	medium
SR	a5	KK	a6	KK	a7	CS	medium
TP	a5	TP	a6	TP	a7	TP	normal
TP	a5	KK	a6	SR	a7	SR	mild
TP	a5	TP	a6	TP	a7	KK	mild
KK	a5	TP	a6	TP	a7	TP	mild
SR	a5	TP	a6	KK	a7	SR	mild
TP	a5	TP	a6	TP	a7	TP	mild
KK	a5	KK	a6	TP	a7	KK	mild
...	...	...	...	...	...	...	...

Table 4. Fuzzy rules

By using Fuzzy rules in Table 4, the Calculation is processed using Simpful Library as follows.

**Pseudocode 2:**

**Output : nilai**

```

1 from simpful import*
5 FS=FuzzySystem( )
6 # Define the consequents
4 FS.set_crisp_output_value("Normal", 0)
FS.set_crisp_output_value("Sedang", 20)
7 FS.set_crisp_output_value("Sedang", 20)
7 FS.set_crisp_output_value("Berat", 30)
8 # Define the fuzzy rules
9 Rule1 = "IF(a1 IS often) OR (a2 IS never) OR
(a3 IS never) OR (a4 IS sometimes) OR (a5 IS

```

sometimes) OR (a6 IS never) OR (a7 IS never)  
THEN (Anxiety IS Normal)"

10  
Rule2 = "IF(a1 IS never) OR (a2 IS never) OR  
(a3 IS never) OR (a4 IS never) OR (a5 IS  
never) OR (a6 IS never) OR (a7 IS never)  
THEN (Anxiety IS Normal)"

11  
Rule3 = "IF(a1 IS sometimes) OR (a2 IS often)  
OR (a3 IS sometimes) OR (a4 IS sometimes)  
OR (a5 IS sometimes) OR (a6 IS almost  
always) OR (a7 IS almost always) THEN  
(Anxiety IS Heavy)"

12  
#Add fuzzy rules to the fuzzy reasoner object

13 FS.add\_rules([Rule1,Rule2,R

14 # Set antecedent values

15 FS.set\_variable("a1",10)

16 FS.set\_variable("a2",10)

17 FS.set\_variable("a3",25)

18 # Perform Sugeno inference and print output

19 print(FS.Sugeno\_inference(["Anxiety"]))

Table 5 : Pseudocode a2

Table 5 shows that the example only has three rules, the same way as the others. Such pseudocode using Python with Simpful Library [16]. Calculation result for anxiety level recommendation can be known in table 6 as follows :

Siswa	Anxiety (DASS-21)		Anxiety (Fuzzy Sugeno)	
	Skor	Level	Skor	Level
1.	6	normal	9,9	normal
2.	0	normal	10	normal
3	24	heavy	19,23	heavy
4.	0	normal	4,8	normal
5.	18	medium	17,14	medium
6.	8	normal	0	normal
7.	16	medium	11,99	medium
8.	16	medium	12,19	medium
9	2	normal	8,91	normal
10.	24	heavy	12	mild
11.	6	normal	11,99	mild
12.	6	normal	11,42	mild
13.	24	heavy	11,84	mild
14.	0	normal	11,42	mild
15.	10	mild	11,28	mild

Tabel 6 : Calculation result of anxiety DASS – 21 and Fuzzy Sugeno

Table 6 has shown the calculation accuracy with the formula as follows :  
accuracy% =  $10/15 * 100 = 66,67\%$   
Accurate level obtained using Fuzzy Sugeno Method is 66.67%.

#### 4. CONCLUSION

Fuzzy Sugeno method is proper to use for early detection of students' anxiety disorder, with an accuracy level of 66.67%. Therefore students can do early detection in mental anxiety disorder without ambiguity and uncertainty. By using the recommendation of anxiety disorder level, teachers can handling and give solutions to students more easily. For Headmasters, this could be a tool for decision-making.

#### 5. SUGGESTION

The Fuzzy Sugeno Method obtained an accuracy of 66.67%. We suggest that SKB or other non-formal education institutions use this method to detect students' anxiety disorders early.

#### REFERENCE

- [1] R. Guthold *et al.*, "The Importance of Mental Health Measurement to Improve Global Adolescent Health," *J. Adolesc. Heal.*, pp. 1–4, 2021, doi: 10.1016/j.jadohealth.2021.03.030.
- [2] Kemenkes, *Undang-undang Republik Indonesia Nomor 18*. Indonesia, 2014.
- [3] WHO, "Anxiety disorders," 2023. <https://www.who.int/news-room/fact-sheets/detail/anxiety-disorders> (accessed Jan. 05, 2025).
- [4] Elin Maulida Rahmawati, Ahman, Setiawati, Zeed Hamdy Rukman, and Dina Dwi Rahayu, "Academic Anxiety Among College Students Reviewed From Gender, Age, and Academic Year Perspective," *G-Couns J. Bimbingan. dan Konseling*, vol. 9, no. 1, pp. 603–618, 2024, doi: 10.31316/gcouns.v9i1.6124.
- [5] K. Memmedova, "Fuzzy logic modelling of the impact of using technology on anxiety and aggression levels of students," *Procedia Comput. Sci.*, vol. 120, pp. 495–501, 2017, doi: 10.1016/j.procs.2017.11.270.
- [6] X. Meng and J. Zhang, "Anxiety Recognition of College Students Using a Takagi-Sugeno-Kang Fuzzy System Modeling Method and Deep Features," *IEEE Access*, vol. 8, pp. 159897–159905, 2020, doi: 10.1109/ACCESS.2020.3021092.
- [7] M. Daffa and S. Sriani, "Penerapan Logika Fuzzy Sugeno untuk Deteksi Tingkat Depresi Kerja Karyawan," *J. Teknol. Sist. Inf. dan Apl.*, vol. 6, no. 3, pp. 484–493, 2023, doi: 10.32493/jtsi.v6i3.32020.
- [8] D. C. Pandey, G. S. Kushwaha, and S. Kumar, "Mamdani fuzzy rule-based models for psychological research," *SN Applied Sciences*, vol. 2, no. 5. 2020, doi: 10.1007/s42452-020-2726-z.
- [9] L. a. Zadeh, "Fuzzy sets," *Inf. Control*, vol. 8, no. 3, pp. 338–353, 1965, doi: 10.1016/S0019-9958(65)90241-X.
- [10] S. Kusumadewi and H. Purnomo, *Aplikasi Logika Fuzzy Untuk Pendukung Keputusan*, 2nd ed. Yogyakarta: Graha Ilmu, 2010.
- [11] N. Nawindah and S. Lydiani, "Fuzzy Inference System Untuk Mendeteksi Kesehatan Mental Mahasiswa," *J. Ilm. Teknol. Inf. Terap.*, vol. 6, no. April, pp. 110–114, 2020, doi: <https://doi.org/10.33197/jitter.vol6.iss2.20.368>.
- [12] M. I. Fale and Y. G. Abdulsalam, "Dr. Flynxz – A First Aid Mamdani-Sugeno-type fuzzy expert system for differential symptoms-based diagnosis," *J. King Saud Univ. - Comput. Inf. Sci.*, no. xxxx, 2020, doi: 10.1016/j.jksuci.2020.04.016.
- [13] Marwondo, J. S. Saputra, H. F. Mahardika, and F. N. Aziz, "Klasifikasi Kebutuhan Dokter untuk Kesejahteraan Masyarakat Menggunakan ANFIS," *Nuansa Inform.*, vol. 18, no. 2, pp. 180–186, 2024, doi: 10.25134/ilkom.v18i2.204.
- [14] P. F. Lovibond, S.H.; Lovibond, "Manual for the Depression Anxiety & Stress Scales." Psychology Foundation, Sydney, 1995.
- [15] D. Muttaqin and S. Ripa, "Psychometric properties of the Indonesian version of the Depression Anxiety Stress Scale: Factor structure, reliability, gender, and age measurement invariance," *Psikohumaniora*, vol. 6, no. 1, pp. 61–76, 2021, doi: 10.21580/pjpp.v6i1.7815.
- [16] S. Spolaor, C. Fuchs, P. Cazzaniga, U. Kaymak, D. Besozzi, and M. S. Nobile, "Simpful: A user-friendly python library for fuzzy logic," *Int. J. Comput. Intell. Syst.*, vol. 13, no. 1, pp. 1687–1698, 2020, doi: 10.2991/ijcis.d.201012.002.