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Implementation of the Psychological Scale Depression Anxiety Stress Scale 21 (Dass-21) in the Expert System for Diagnosing Mental Health Disorder

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ABSTRACT

Mental health is something that needs to be considered properly because if the mental is disturbed then the body also feels the impact. Mental health disorders including depression, stress, and anxiety can affect anyone, especially students. Due to the lack of awareness of mental health in students and the minimal number of clinical psychologists in Indonesia, students are reluctant to see a psychologist. The existence of an expert system for early detection of mental health disorders using the Depression Anxiety Stress Scale (DASS-21) with 21 symptoms can help students analyze the level of mental health disorders which are divided into depression, stress, and anxiety. The results of the study based on 100 student data of Nusa Cendana University obtained the system can diagnose mental health disorders including depression, stress, and anxiety with an accuracy rate of expert and system results of 100% which shows that the implementation of the DASS-21 instrument into the system is correct. Findings from the diagnosis results show that most students (70%) suffer from anxiety in the moderate to severe category. However, special attention needs to be paid to students who suffer from moderate to severe depression (37%) and severe to moderate stress (36%).



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1. INTRODUCTION

Mental health problems in students are real and they are as important as physical problems. This mental health problem can affect a student's psychology and make them feel uncomfortable interacting and closing themselves off from other people around them. The presence of mental health disorders has a significant impact on several aspects of a student's life, with particular emphasis on their academic situation.

In research conducted [1] regarding mental awareness among UPN Veteran Yogyakarta students, it was found that there was a general tendency among students to self-diagnose, which may be caused by their limited understanding of mental health problems and inadequate access to relevant information. Apart from this research, further research has been carried out [2] regarding the mental health of students at College and poor mental health by 41%. Other research [3] on a sample of 258 students in Indonesia between July and August 2021 showed that the majority of students experienced moderate depression (12.8%), very severe anxiety (20.9%), and severe stress (13.6%).

Based on research results [1], [2], and [3] it is known that mental health disorders in students are something that commonly occur without even the students themselves realizing it. Even though they know, students just keep quiet or, worse, make the wrong self-diagnoses about their mental health. Apart from the minimal number of psychologists in Indonesia, namely only 3585 people [4], feelings of low self-esteem, shame and fear of what people around will think are factors that trigger students to be reluctant to consult psychologists and tend to hide themselves from other people.

The reluctance of people with mental health difficulties to seek professional treatment or acknowledge their condition may be due to a lack of information among students about mental health and the societal perception that interacting with a psychologist is an indication of mental instability [5]. Therefore, it is critical to develop solutions that facilitate the dissemination of information and accelerate the timely identification of mental health illnesses. This can be achieved through the application of expert systems, which is a type of artificial intelligence technology that assimilates expert knowledge and empowers computers to effectively address complex problems, like human experts. The system in question is similar to an expert assistant, which can integrate the knowledge of psychology experts into a web-based platform, thus turning it into a consultation facility that meets student needs[6]. The proposed system will be developed as a web-based application, thus offering easy accessibility without requiring installation.

The instrument used in this research is the Depression, Anxiety, Stress Scale-21 (DASS-21) which has been widely adopted because of its well-established psychometric properties and is available in Indonesian so it is suitable for use in the Indonesian context. Additionally, it is worth noting that DASS-21 is a derivative of DASS-42, which was designed to be more compact and simpler to administer [7].

Research on the mental health problem diagnosis system using DASS-42 has been carried out by [8], [9], [10] with satisfactory results. However, the DASS-42 instrument has 42 questions that must all be answered by the user. The DASS-21 instrument has also been used in research [11] using certainty factor (CF) weighting. Research [12] also used the DASS-21 instrument but with the Self Rating Questionnaire 20 (SRQ-20) questionnaire feature which contains 20 questions. Specifically, this research aims to develop a mental health diagnosis system based on the DASS-21 instrument with symptom weighting based on symptom frequency [13].

2. RESEARCH METHOD

2.1. Data Source

This research uses primary data collected directly from students registered in eight study programs (Civil Engineering, Mechanical Engineering, Computer Science, Biology, Physics, Chemistry, Mathematics, Electrical Engineering) from the 2018, 2019 and 2020 graduates at Nusa Cendana University. This data was collected through interviews and observations, including questionnaires administered via Google Forms. The DASS-21 instrument was obtained from expert Mr. R. Pasifikus C. Wijaya, S.Psi., MA, a psychologist and lecturer in the Psychology study program at Nusa Cendana University. Experts also provide diagnostic data based on primary data on symptoms of mental health disorders experienced by students.

2.2. DASS-21 Psychological Scales

This research uses the DASS-21 psychological scale with the variable to be measured is the type of mental health in students. The DASS-21 instrument was obtained [13] with translation into Indonesian by an expert. This variable includes 21 symptoms related to three types of psychological stress called indicators, namely depression, anxiety, and stress. The distribution of symptoms for each indicator can be seen in Table 1 with a total of 7 symptoms.

Table 1. DASS-21 pressure categories.

Variable	Indicator	Symptoms	Number of Symptoms
Types of mental health in students	Depression	3,5,10,13,16,17,21	7
	Anxiety	2,4,7,9,15,19,20	7
	Stress	1,6,8,11,12,14,18	7

Each symptom is assigned a weight ranging from 0 to 3. The numerical scale used in this context assigns a specific value to represent the frequency of the symptom. A value of 0 indicates there are no symptoms, or they do not occur at all. A value of 1 indicates symptoms that applied to some degree or some of the time, while a value of 2 indicates symptoms that applied to a considerable degree or a good part of the time. Finally, a value of 3 indicates that the symptom applied very much or most of the time. Table 2 summarizes the symptom weighting for each symptom frequency.

Table 2. Symptom Weight based on symptom frequency.

Symptom Frequency	Symptom Weight
Did not apply to me at all	0
Applied to me to some degree, or some of the time	1
Applied to me to a considerable degree or a good part of time	2
Applied to me very much or most of the time	3

There are five categories for each variable, which are referred to as Normal, Mild, Moderate, Severe, and Very Severe categories. To calculate the total weight, the symptom weight for each of the seven

symptoms in Table 1 is multiplied by two [14]. Table 3 shows the total category weights for each variable. For example, for the Stress variable, the general range for scores at the normal level is between 0 and 14. Scores at the mild level are often seen in the range 15 to 18. Moderate levels are characterized by scores that range between 19 to 25. Scores are between 26 and 33 indicating the severity of the condition. Lastly, the very severe level is determined by a score equal to or greater than 34.

The Depression Anxiety Stress Scales (DASS) show strong validity and reliability when used in clinical and non-clinical groups in the Indonesian context. In general, the Cronbach's alpha reliability test produces a high level of dependence ($\alpha = 0.9483$). The reliability test for each item shows strong internal consistency, namely for depression ($\alpha = 0.9053$), stress ($\alpha = 0.8806$), and anxiety ($\alpha = 0.8517$) [15]. Confirmatory factor analysis shows that the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) have a higher value, namely 0.90 [16].

Table 3. Total weights per variable

Category	Total Weight		
	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Very Severe	28+	20+	34+

2.3. Calculation Process with the DASS-21 Scale

After students answer each symptom by selecting the appropriate symptom frequency on the DASS-21 questionnaire, the answer choices are then grouped based on three disorders, namely depression, anxiety, and stress. This grouping can be seen in Table 1. After grouping, each answer choice in these statements will be added up and then multiplied by two. The results obtained will be seen at the level according to the DASS-21 scale rules.

- a) Calculate the weight of each symptom.

The weight of each symptom in each indicator is calculated based on the frequency of symptoms provided by the user. Symptom frequency weighting is determined by Table 3.

- b) Determine the total weight of each indicator.

Each indicator has 7 symptoms as in Table 1. The total weight of each indicator is calculated using Equation 1 [14]

$$\text{Total_Weight [i]} = (\sum_{g=1}^7 \text{Symptoms_Weight [g]}) \times 2 \tag{1}$$

Where:

Total_Weight [i]: total weight for the ith indicator.

i: indicators (depression, anxiety, stress)

g: symptoms of each indicator

Symptoms_Weight [g]: weight of symptom g

- c) Determine the mental health category.

The formation of mental health category rules can be done by referring to Table 2.

1. Determination of mental health level for depressive disorders (J[1])

Rule 1: If Total_Weight [1] ≥ 0 and J[1] ≤ 9 then TK1

Rule 2: If Total_Weight [1] ≥ 10 and J[1] ≤ 13 then TK2

Rule 3: If Total_Weight [1] ≥ 14 and J[1] ≤ 20 then TK3

Rule 4: If Total_Weight [1] ≥ 21 and J[1] ≤ 27 then TK4

Rule 5: If Total_Weight [1] ≥ 28 then TK5

2. Determining the level of mental health for anxiety disorders (J[2])

Rule 1: If Total_Weight [2] ≥ 0 and J[2] ≤ 7 then TK1

Rule 2: If Total_Weight [2] ≥ 8 and J[2] ≤ 9 then TK2

Rule 3: If Total_Weight [2] ≥ 10 and J[2] ≤ 14 then TK3

Rule 4: If Total_Weight [2] ≥ 15 and J[2] ≤ 19 then TK4

Rule 5: If Total_Weight [2] ≥ 20 then TK5

3. Determining the level of mental health for stress disorders (J[3])

Rule 1: If Total_Weight [3] ≥ 0 and J[3] ≤ 14 then TK1

Rule 2: If Total_Weight [3] ≥ 15 and J[3] ≤ 18 then TK2

Rule 3: If Total_Weight [3] ≥ 19 and J[3] ≤ 25 then TK3

Rule 4: If Total_Weight [3] ≥ 26 and J[3] ≤ 33 then TK4

Rule 5: If Total_Weight [3] ≥ 34 then TK5

Where:

Total_Weight [1]: Depression, Total_Weight [2]: Anxiety, Total_Weight [3]: Stress, TK1: Normal, TK2: Mild, TK3: Moderate, TK4: Severe, TK5: Very Severe

2.4. System Flowchart

In the context of an expert system flowchart, there are two different categories of users interacting with the system: administrators and students. To gain access to the system, the administrator will be asked to enter a username and password, after which the system will continue the login procedure. Next, the system will validate the login procedure. If the login is incorrect, the system will ask the administrator to re-enter the username and password. After the login procedure is successfully authenticated, the administrator continues to enter Symptom Data, Variable Data and Category data. This information is then stored in a database for further analysis and use in calculating Mental Health Level Categories. The system then presents information regarding data that has been previously input, including Symptom Data, Variable Data, and category data, which can be accessed by administrators.

When wanting to do a consultation, students are asked to input their username and password or register an account if they don't have an account. After registering an account and then carrying out the login process, the system will display a consultation form in the form of questions regarding symptoms of mental health disorders to be filled in by the student concerned. Students are asked to fill in the answer choices displayed based on the symptoms they are experiencing. The symptom data will then be processed using the DASS-21 calculation method, then the resulting mental health level score calculation will be stored in the database. After that, the system will display the results of the consultation which can be printed by students.

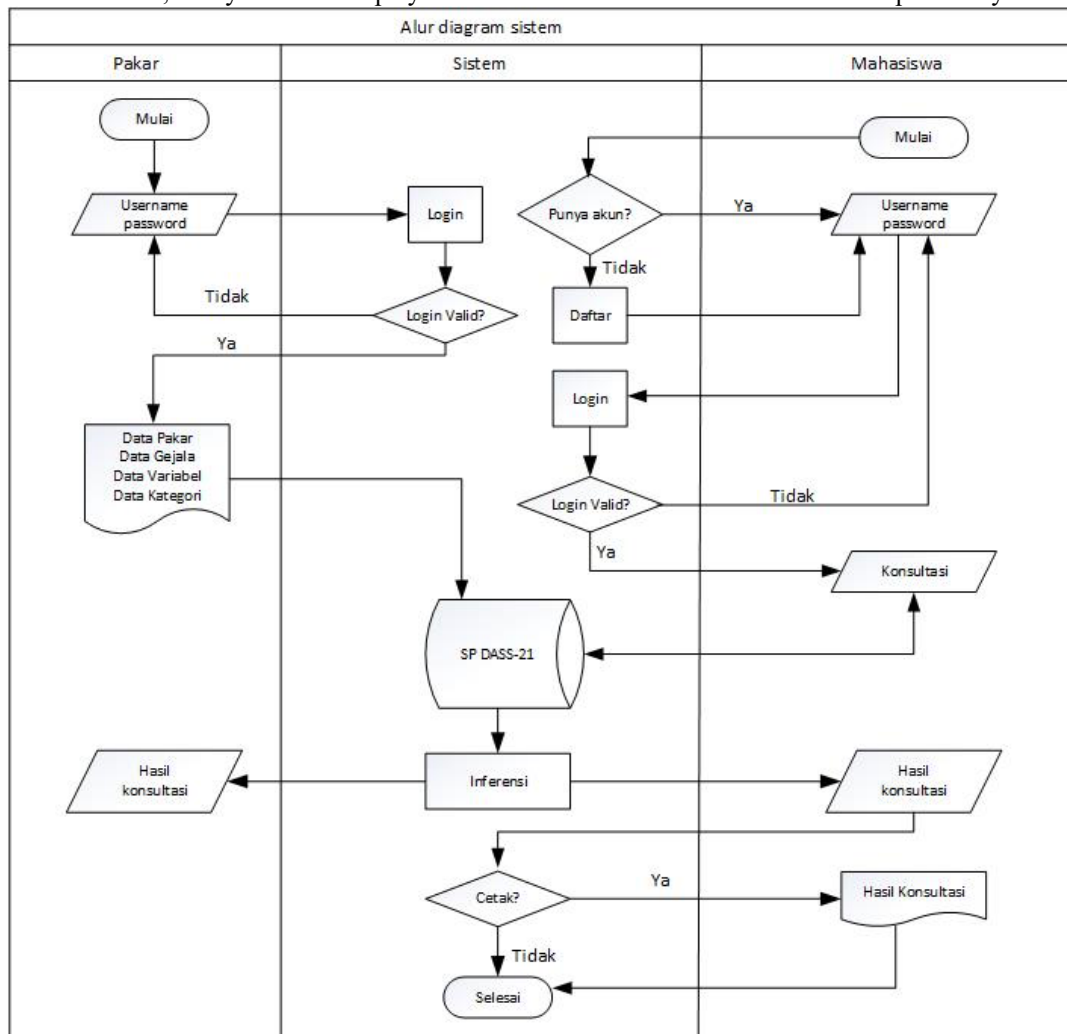


Figure 1. System Flowchart

3. RESULT DAN ANALYSIS

This research produces an expert system for mental health diagnosis in students which can be accessed at <https://cekdepresi.my.id/>. Each student will have their level of depression, anxiety and stress measured so that every time a consultation is carried out, the student will get their level of depression, anxiety level and stress level. Students who experience depression in the normal category can experience severe anxiety and severe stress, and vice versa. These results depend on how students fill in the answer choices given in the DASS-21 questionnaire. An example of a calculation taken from one of the student data used in this research using the DASS-21 scale can be seen in Table 4. In Table 4, users answer 21 questions from the first symptom (G01) to the 21st symptom (G21) with Symptom_Weight being the result of Symptom frequency conversion from user answers based on Table 3.

Tabel 4. Contoh perhitungan DASS-21

Symptoms	Symptom_Weight	Variable		
		Depression	Anxiety	Stress
G01	2			2
G02	1		1	
G03	1	1		
G04	1		1	
G05	2	2		
G06	1			1
G07	2		2	
G08	2			2
G09	2		2	
G10		0		
G11	1			1
G12				0
G13	2	2		
G14	2			2
G15	1		1	
G16		0		
G17	1	1		
G18				0
G19	1		1	
G20	1		1	
G21	1	1		
Sum of Symptom Weight		7	9	8
Total Weight (equation 1)		14	18	16

The dataset used in this research consists of 100 data. To validate this research, an assessment of the system's accuracy was carried out by comparing the expert diagnosis results with the system diagnosis results. The column for data in a category shows the amount of data diagnosed because of the system diagnosis that falls into a particular category. Table 5 presents a comparative analysis of the results of expert diagnosis and system calculations. The Status column in Table 5 shows the suitability of the expert diagnosis and the system.

Table 5. Comparison of expert and system diagnosis results

Variable	Category	Number of data in category		Status
		Expert	System	
Depression	Normal	41	41	Expert diagnosis is the same as the system's
	Mild	22	22	Expert diagnosis is the same as the system's
	Moderate	23	23	Expert diagnosis is the same as the system's
	Severe	9	9	Expert diagnosis is the same as the system's
	Very Severe	5	5	Expert diagnosis is the same as the system's
Total Data		100		
Anxiety	Normal	19	19	Expert diagnosis is the same as the system's
	Mild	11	11	Expert diagnosis is the same as the system's
	Moderate	30	30	Expert diagnosis is the same as the system's
	Severe	14	14	Expert diagnosis is the same as the system's
	Very Severe	26	26	Expert diagnosis is the same as the system's
Total Data		100		
Stress	Normal	44	44	Expert diagnosis is the same as the system's

Mild	20	Expert diagnosis is the same as the system's
Moderate	22	Expert diagnosis is the same as the system's
Severe	9	Expert diagnosis is the same as the system's
Very Severe	5	Expert diagnosis is the same as the system's
Total Data	100	

For anxiety disorders, many students experienced moderate levels of anxiety, namely 30 students, followed by very severe levels, 26 students, and the fewest were mild levels of anxiety, 11 students. For depressive disorders, more students experienced normal levels of depression, namely 41 students, and fewer students experienced very severe levels of depression, only 5 students. This also applies to stress disorders, namely 44 students experienced normal levels of stress and only 5 students experienced very severe levels of stress. The results of this research found a general phenomenon that based on the dataset used, it was found that 70% of students were in the Moderate to Very Severe category for the Anxiety variable. In contrast, the level of depression in the Moderate to Very Severe category was 37% and the level of Stress in the Moderate to Very Severe category was 36%. High levels of anxiety should be a cause for concern because they have the potential to become depression or stress if not handled properly. Apart from that, the finding of quite large levels of depression and stress in the Moderate to Very Severe category also requires a solution to be found. However, the results shown in Table 5 are only for the dataset used. A thorough search for all students needs to be carried out and may provide varying results.

Data analysis shown in Table 5 shows consistent alignment between expert diagnosis data and system diagnosis. The observed phenomenon is characterized by the absence of disparity between the calculation results produced by experts and those produced by the system. Additionally, all levels of disease are accurately represented, and diagnoses align with those made by experts. Therefore, it can be concluded that the system shows an accuracy level that reaches 100%. These results show that the system developed is according to the business rules of DASS-21. This does not indicate that the system can replace human experts because, in this diagnosis, the system only relies on the user's answers given to the system regarding the frequency of symptoms experienced. Further considerations regarding the correctness and honesty of user answers must still be explored by experts. In addition, treating mental health problems involves many complex and personal matters so expert treatment for each case is very necessary.

4. CONCLUSION

Based on the findings obtained from testing carried out, it can be concluded that the expert system that utilizes the DASS-21 scale has demonstrated its efficacy in identifying indications of Depression, Anxiety and Stress, reaching a system accuracy level of 100%. These results show that the DASS-21 business rules have been applied correctly to the system. These results do not show the system's ability to replace experts in handling mental health problems because handling mental health problems must be carried out comprehensively and personally.

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