

Toward Effective Mental Health Detection: Implementing Forward Chaining Method with DASS-21

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ABSTRACT

Keywords:

Mental Health
Forward Chaining
Depression
Anxiety
Stress

Mental health is an important aspect of quality of life that is often overlooked. This study aims to design a website-based application called Serenity which is used to detect mental health conditions in the categories of depression, anxiety, and stress. This application utilizes the Depression Anxiety Stress Scale-21 (DASS-21) as a measurement tool and applies the Forward Chaining method to interpret the examination results. In the first stage, a needs analysis is carried out to determine the features to be developed in the application. After that, a system design was carried out that included designing an intuitive and easy-to-use user interface and user experience. The implementation process involves coding using PHP, CSS, Java Script, integration with MySQL databases, and system testing to ensure optimal functionality. The results showed that the Serenity application had an excellent performance with a score of 98% in the PageSpeed Insight test. The system was tested using black box testing which involved users showing results that met expectations and providing accurate results in detecting the user's mental health condition.

INTRODUCTION

Mental health is very important for a person's life, especially in the field of education, especially among students. In order to study smoothly, all students must be in good physical and mental condition (Nurhafiyah & Marcos, 2023). According to the Law of the Republic of Indonesia No. 17 of 2023 concerning health states that health is a condition of a person who is physically, mentally, and socially healthy, not just free from disease that allows him to live productively [2]. In addition, WHO (World Health Organization) also explains that health is a state of complete physical, mental, and social well-being, not just free from disease and weakness (Adam & Marfuah, 2022; Ayuningtyas et al., 2018). When a person can develop physically, mentally, spiritually, and socially so that they have an awareness of their own abilities (the ability to cope with stress, the ability to work productively, and the ability to contribute to their community) then, that person can be categorized as mentally healthy (Government of Indonesia, 2014).

Student mental health issues are changing and increasing (Adil & Muzdalifah, 2021). College students are more likely to experience mental emotional health disorders, including depression, anxiety, and other psychiatric problems that have comorbidities (Wahyuni & Winarso, 2022). Because university students are a group of people living in a critical transition period from adolescence to young adulthood (Auerbach et al., 2018). Moreover, compounded by the challenging transition from high school to college, academic pressures, social adaptation, and management of newfound independence. Alarmingly, the WHO reports an increase of more than 25% in common conditions such as depression and anxiety since 2020, affecting nearly one billion people worldwide (Alalalmeh et al., 2024). These mental illnesses affect up to 10% of the global population, and contribute 30% of all non-fatal illnesses worldwide (Ifdil et al., 2020). According to data from the Health Research and Development Agency, in 2006, the number of suicides

in Indonesia each year reached 1800 people. According to this data, 47.7% of suicide victims were aged 10-39 years old (Mayatopani et al., 2022).

In addition, the results of the 2018 Basic Health Research published by the Ministry of Health of the Republic of Indonesia 6.1% of people aged 15 years and over suffer from mental disorders with symptoms of depression and 9.8% suffer from mental emotional disorders. Meanwhile, 6.2% of people suffering from depression and 10% of people suffering from mental emotional disorders are aged between 15-24 years old (Adam & Marfuah, 2022; Adil & Muzdalifah, 2021; Health Research and Development Agency, 2019; Wahyuni & Winarso, 2022). From the news circulating, mental health problems can cause quite dangerous impacts, one of which is death. For example, in the suicide case of one UMY student who committed the action by drinking 20 grains of headache medicine at once on October 1, 2023. The cause of suicide is due to mental health problems. In another case, in October 2022 there was also a suicide case committed by a UGM student, namely by jumping from the 11th floor at a hotel in Yogyakarta. The local police revealed that the victim committed suicide because he had a psychological disorder (Chairunnisa & Dwi, 2023).

By looking at the impact and magnitude of the risk caused by mental health disorders, the effort to recognize mental health disorders is to conduct early detection so that treatment is carried out in the early phase. Early detection is done by filling out the Depression Anxiety Stress Scale-21 (DASS)-21 questionnaire for analysis. DASS-21 is used to assess a person's negative emotional symptoms designed to measure the presence and severity of symptoms of depression, anxiety, and stress (Ifdil et al., 2020). From these symptoms, it will produce five classifications namely, normal, mild, moderate, severe and very severe as a result of early detection (Alalalmeh et al., 2024; Priya et al., 2020; Wahyuni & Winarso, 2022). The advantages of DASS-21 are that it is valid and reliable for measuring depression, anxiety, and stress in college students (Arjanto, 2022). Therefore, DASS-21 is suitable for use in research contexts and clinical applications, including in technology-based mental health detection systems (Ifdil et al., 2020). Meanwhile, the Forward Chaining method is one of the inference methods in rule-based systems. This method works by starting from existing facts and then using rules to get a conclusion or final result (Rizkiah et al., 2020). One of the advantages of the Forward Chaining method is that it is able to determine the diagnosis results using the available information and perform inference based on predetermined rules (Fatih Sudirja et al., 2023).

Based on this background, this research aims to develop a mental health detection system using the Forward Chaining method which involves the use of the Depression Anxiety Stress Scale-21. It is hoped that this system can help detect mental health problems early on, enable interventions to be made, and increase awareness of the importance of mental health early on. In addition, this research can be used as a model for building similar systems in other educational institutions.

RESEARCH METHOD

The research flow depicted in figure 1 below is to provide an overview of the stages or sequence carried out in the research process to design a website to obtain and collect data with predetermined objectives.

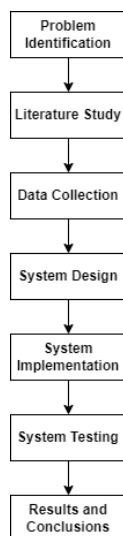


Figure 1. Research Flow

The initial stage that must be done in research is to identify problems regarding the topic taken, namely the lack of student awareness of mental health. So, in this research, a solution is made in the form of designing an application system that can detect mental health such as depression, anxiety, and stress.

The measuring instrument used in this study is the Depression Anxiety Stress Scale-21 (DASS-21) which has been translated into more than 40 languages and one of them is Indonesian. In DASS-21 there are 21 questions used to detect depression, anxiety, and stress. This measuring instrument has been tested for reliability with item reliability of 0,99 and person reliability of 0,89 with these values, it can be said that the items used in DASS-21 are valid and reliable (Ifdil et al., 2020). To use DASS-21 in the process of detecting depression, anxiety, and stress, the following knowledge base is used:

1. Detection Question Knowledge Base

Data for this study was collected through the Depression Anxiety Stress Scale-21 (DASS-21) which consists of 21 questions with 7 questions for each of the stress, anxiety, and depression scales. Each question has a different code consisting of S for stress, D for depression, and A for Anxiety as found in table 1.

Table 1. DASS-21 Questions

Code	DASS-21 Questions
S1	Difficult to calm down
A1	Dry mouth
D1	No positive feelings
A2	Difficulty breathing
D2	No initiative in doing things
S2	Overreaction to situations
A3	Trembling

S3	Spending a lot of energy when anxious (nervous)
A4	Worry when panicking
D3	Loss of interest
S4	Restless
S5	Difficult to relax
D4	Sadness and despair
S6	Intolerant of distractions or obstacles
A5	Almost panicked
D5	Pessimist
D6	Life is not valuable and meaningful
S7	Easily offended
A6	Changes in heart rate
A7	Fear for no reason
D7	Life is meaningless (feeling unworthy)

The answer to each question has the following answer score (Priya et al., 2020) as shown in table 2 below:

Table 2. Score Answer

Value	Description
0	Does not apply to me (never)
1	Applied to me to some degree or some of the time (sometimes)
2	Applied to me for most or most of the time (often)
3	Applied to me very much or most of the time (very often)

2. Detection Rule Knowledge Base

The detection rule knowledge base contains rules for tracking mental health detection results in the system. With Forward Chaining, the concept of inference is done using a production rule (IF ... THEN). Detection rules can be seen in table 3 (Wahyuni & Winarso, 2022):

Table 3. Mental Health Detection Rule

Name of Mental Health Disorder	IF-THEN Rule
Stress	IF Difficult to rest (S1) OR Overreaction to things (S2) OR Spends a lot of energy when anxious (S3) OR Restless (S4) OR Difficult to relax (S5) OR Impatient with annoyances or obstacles (S6) OR Irritable (S7) THEN Stress
Depression	IF No positive feelings (D1) OR No initiative in doing things (D2) OR Loss of interest (D3) OR Sad and hopeless (D4) OR Pessimistic (D5) OR Life is not valuable and meaningful (D6) OR Life is meaningless (D7) THEN Depression

Anxiety Disorder	IF Dry mouth (A1) OR Difficulty breathing (A2) OR Trembling (A3) OR Worry during panic (A4) OR Near panic (A5) OR Change in heart rate (A6) OR Fear for no reason (A7) THEN Anxiety Disorder
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3. Mental Health Tier Rule Knowledge Base

This knowledge base contains rules to determine the level of a person's mental health disorder. Each mental health disorder has rules in determining the level of mental health. The rules for mental health levels in the stress category can be seen in table 4 (Priya et al., 2020):

Table 4. Stress Levels Rule

Tiers	RULE
Normal	IF sum of weights ≤ 14 THEN Normal
Lightweight	IF sum of weights ≤ 18 THEN Mild Stress
Medium	IF sum of weights ≤ 25 THEN Moderate Stress
Weight	IF sum of weights ≤ 33 THEN Severe Stress
Very Heavy	IF sum of weights ≥ 34 THEN Very Severe Stress

The rules for mental health levels in the depression category can be seen in table 5 (Priya et al., 2020):

Table 5. Depression Levels Rule

Tiers	RULE
Normal	IF sum of weights ≤ 9 THEN Normal
Lightweight	IF sum of weights ≤ 13 THEN Mild Depression
Medium	IF sum of weights ≤ 20 THEN Moderate Depression
Weight	IF sum of weights ≤ 27 THEN Severe Depression
Very Heavy	IF sum of weights ≥ 28 THEN Severe Depression

The rules for mental health levels in the anxiety category can be seen in table 6 (Priya et al., 2020):

Table 6. Anxiety Levels Rule

Tiers	RULE
Normal	IF sum of weights ≤ 7 THEN Normal
Lightweight	IF sum of weights ≤ 9 THEN Mild Anxiety Disorder
Medium	IF sum of weights ≤ 14 THEN Moderate Anxiety Disorder
Weight	IF sum of weights ≤ 19 THEN Severe Anxiety Disorder
Very Heavy	IF sum of weights ≥ 20 THEN Severe Anxiety Disorder

RESULTS AND DISCUSSION

System implementation is carried out to define the results of system design that has been made into a web-based application using the Forward Chaining and DASS-21 methods. This system design uses HTML, CSS, and PHP programming languages. In addition, the necessary data will be stored and managed through the MySQL database. This system is designed to assist users in detecting mental health based on symptoms of stress, anxiety, and depression. Thus, the development of this system aims to provide an effective solution in helping users to get the right treatment.

Result

The application of the Forward Chaining method in the Serenity application is used for the process of interpreting the examination results to produce five classifications for each disorder (depression, anxiety, stress), namely normal, mild, moderate, severe, very severe. The Forward Chaining method is used in the process of matching the facts and data obtained with the rules and knowledge base. The stages of the Forward Chaining method to interpret the examination results are as follows:

1. Completing the DASS-21 Questionnaire which has been adapted into a web-based application through Serenity. Filling out the questionnaire by filling in 7 questions on each disorder (depression, anxiety, stress) as shown in Figure 2.

The screenshot shows a web-based questionnaire interface with seven questions. Each question is followed by four radio button options: 'Never', 'Sometimes', 'Often', and 'Very Often'. Below each question is a green 'Serenity' button. The questions are:

- I feel my mouth is dry
- I have difficulty breathing
- I feel shaky (for example, in my hands)
- I feel worried when I panic
- I feel nervous
- I feel changes in my heart rate even when I am not doing any activity (e.g., rapid breathing, labored breathing)
- I feel scared for no apparent reason

Figure 2. Questionnaire Filling

2. Calculate the score or value by adding up the values which are then multiplied by 2 in each category with the following formula:

$$\text{Stress} = (S1 + S2 + S3 + S4 + S5 + S6 + S7) \times 2 \quad (1)$$

$$\text{Depression} = (D1 + D2 + D3 + D4 + D5 + D6 + D7) \times 2 \quad (2)$$

$$\text{Anxiety} = (A1 + A2 + A3 + A4 + A5 + A6 + A7) \times 2 \quad (3)$$

The calculation of each category in the application is displayed as shown in Figure 3.

A1	I feel my mouth is dry	0	1	2	3
A2	I have difficulty breathing	0	1	2	3
A3	I feel shaky (for example, in my hands)	0	1	2	3
A4	I feel worried when I panic	0	1	2	3
A5	I feel nervous	0	1	2	3
A6	I feel changes in my heart rate even when I am not doing any activity (e.g., rapid breathing, labored breathing)	0	1	2	3
A7	I feel scared for no apparent reason	0	1	2	3

Figure 3. Category Calculation

- Interpret the results of summing the values which are then multiplied by 2 in each category with the rules and knowledge base of the Forward Chaining method. The application of the Forward Chaining method by matching the results of each category will produce inspection results as shown in Figure 4.

No.	Results	Test Time	Action
1	Severe Anxiety	25 July 2024 10:47:03	Detail
2	Very Severe Anxiety	22 July 2024 12:17:36	Detail
3	Normal Depression	22 July 2024 12:01:40	Detail
4	Mild Depression	21 July 2024 16:19:50	Detail
5	Normal Stress	08 July 2024 18:24:33	Detail
6	Normal Stress	04 July 2024 17:42:52	Detail
7	Very Severe Anxiety	04 July 2024 17:42:10	Detail
8	Moderate Depression	04 July 2024 17:39:43	Detail

Figure 4. Interpretation of Examination Results

In Figure 4, the calculation results in each category will produce examination results in the form of normal, mild, moderate, severe, very severe in each depression/anxiety/stress disorder.

Performance Testing

Performance testing is done using PageSpeed Insight. The results of the Serenity application performance testing are as follows:

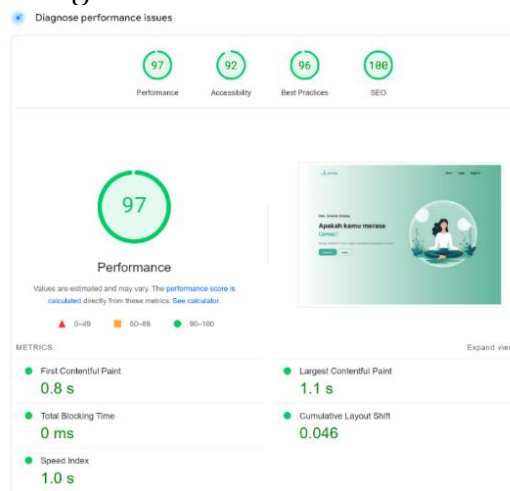


Figure 5. Performance Test

In figure 5, the performance test results of the Serenity application is 98%. These results are good and it can be said that the Serenity application already has almost perfect performance.

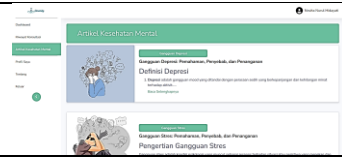



System Testing

The system testing process for the Serenity mental health detection application by implementing the Forward Chaining method with the interpretation of results using the Depression Anxiety Stress Scale-21 (DASS-21), using black box testing, this test is a system testing process to ensure that the output produced is appropriate. This system test is carried out first independently by trying all the features contained on the website as a whole. After that, direct testing was carried out by involving students of the Faculty of Vocational Studies, Surabaya State University and an expert/expert from the Psychology

S1 lecturer at Surabaya State University. This testing allows the identification and resolution of problems before full implementation of the system, thus ensuring a smooth and efficient user experience. The results of system testing can be defined as in table 7.

Table 7. System Testing

No.	Activities Testing	Expected Results	Results
1.	Open Serenity website	Display the home page	Valid
2.	Registering an account	Display the account registration menu	Valid
3.	Doing Log in	Display the login menu then display the dashboard menu if successfully logged in	Valid
4.	Mental health consultation	Display questions about mental health then display the results after answering all question	Valid
5.	View the results of mental health consultation history	Display the consultation history menu and can also find out the details	Valid
6.	View the mental health article menu	Display the mental health article menu and then the users can also read the articles	Valid

		
7. Make changes to profile data	Display the my profile menu	
		Valid
8. Doing Log out	Display the log out confirmation tab	
		
	then return to the home page if agree to log out	Valid
		

CONCLUSION

Based on the research, it can be concluded that a website application called "Serenity" was successfully developed to detect symptoms of depression, anxiety, and stress early using the Forward Chaining method and the effective DASS-21 measuring instrument. This application has an intuitive display and features such as filling out questionnaires, calculating scores, and classifying results. The performance test showed a success rate of 98%, which means that this application is almost perfect in detecting mental health conditions and is ready for widespread use. System testing is done with black box testing to ensure the output matches the input given, starting with basic functionality testing and continuing with further testing to ensure the application works well under various conditions.

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