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Implementation of the Forward Chaining Algorithm in a Student Mental Health Detection System

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Abstract

Student mental health is an important aspect in supporting academic success and individual well-being. The various academic pressures, social challenges, and the transition to independent living make students a vulnerable group to mental health disorders such as stress, anxiety, and depression. However, many students are still reluctant or experience difficulties in accessing professional services to solve this problem. This research aims to develop an early detection system for student mental health based on an expert system using Forward Chaining. This method performs reasoning from symptoms toward a conclusion based on mental health condition using rules stored in the knowledge base. The system is developed using the DASS-21 (Depression, Anxiety, Stress Scale-21) instrument to assist in identifying mental health conditions. The dataset consists of 50 student respondents from Universitas Muhammadiyah Ponorogo who completed the DASS-21 questionnaire. System performance was evaluated by comparing the diagnostic outputs of the system against the standard DASS-21 score. The results were analyzed using a confusion matrix to calculate accuracy, precision, recall, and F1-score per severity class. The research results show that the system is capable of initially identifying students' mental health conditions by presenting the severity level of the mental condition, a description of the condition, and appropriate handling recommendations. Black-box testing confirmed the accuracy of 96%, with precision and recall values above 90% across all severity classes. These results demonstrate that the implemented forward chaining system provides an accessible, automated, and standardized tool for early mental health detection in the Indonesian higher education context.

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1. Introduction

Mental health is a psychological condition that reflects a person's ability to adapt and solve internal and external problems, including how they think, feel, and act when facing life challenges and stress [1]. Student mental health has become a major concern in higher education due to academic demands, the transition to independent living, and social pressures that can affect emotional stability and overall well-being. Mental disorders, such as histrionic personality disorder, may influence how individuals perceive themselves and seek attention from others, potentially causing negative impacts on their mental condition [2], and in more severe stages, students experiencing mental health disorders may even attempt suicide [3].

Based on the Indonesian Basic Health Survey (RISKESDAS), the prevalence of depression among individuals aged 15–24 years is 6.2% [4], which includes students as a vulnerable group to mental health problems. Furthermore, research conducted in China over the last 20 to 30 years indicates an increasing trend in adolescent mental health issues, with 11% experiencing worsening psychological problems and 2–3% facing more severe conditions [5], while in Indonesia, a study by Zulfikar in 2021 in North Sumatra

found that 35% of students experienced stress due to accumulated academic tasks and environmental pressures [6].

According to several journals and articles on student mental health research, common psychological symptoms experienced by students include anxiety, panic, nausea, loss of appetite, insomnia, excessive sadness, and unexplained anger, while those with mental health problems often face difficulties in completing assignments, disruptions in the learning process, decreased cognitive ability, and reduced interest in studying [7]. It is essential for students experiencing mental health issues to seek help from mental health professionals, as understanding the relationship between self-concept and student mental health is important not only for personal development but also for academic performance and overall well-being, making research that functions as a mental health predictor valuable for developing more effective intervention and support programs in higher education environments [2]. Based on observations and interviews with an expert, Mrs. Afitria Rizkiana, M.Psi., Psychologist, several field problems were identified that cause students to hesitate to visit psychologists or psychiatrists, including a lack of social support regarding the importance of seeking professional help [8], limited knowledge about formal counseling services so that students do not know where to obtain appropriate assistance [9], inadequate time management skills that hinder their ability to balance academic responsibilities while seeking psychological help [10], and low mental health literacy as well as limited mental health facilities in society, which prevent students from understanding the importance of proper mental health treatment [11].

Despite the growing body of literature on student mental health, there remains a significant research gap: most existing studies focus on manual screening or clinical assessment tools that require professional involvement, while automated, rule-based systems that leverage expert knowledge to provide immediate, accessible initial detection remain underexplored, particularly in the Indonesian higher education context. Furthermore, prior implementations of expert systems for mental health have rarely integrated a standardized, validated instrument such as DASS-21 with forward chaining inference, leaving a gap in terms of both methodological rigor and practical applicability for student populations. Based on these problems, a system is needed to assist in the identification process of determining the type of mental health disorder based on symptoms and complaints experienced by users. The developed system is based on the concept of an expert system, which imitates the reasoning process of an expert through the application of rules (rule-based system) to produce an appropriate diagnosis. This research applies the Forward Chaining method, a reasoning technique that begins with facts or symptoms provided by the user and then matches them with rules stored in the knowledge base until a conclusion is obtained. Several previous studies have implemented the Forward Chaining method in expert systems for diagnostic purposes, including research conducted by Fernando in 2022 entitled "Implementation of Forward Chaining in the Online Game Addiction Diagnosis Expert System" [12]. The Forward Chaining method is considered suitable for addressing mental health disorders that involve various combinations of symptoms, as it can process relationships between symptoms and levels of disorders gradually through rules defined by experts, resulting in a structured and understandable diagnosis. The instrument used to support mental health identification in this study is DASS-21 (Depression, Anxiety, Stress Scale-21), a multidimensional measurement tool widely used by researchers in Indonesia and internationally to assess depression, anxiety, and stress. DASS-21 is chosen because it is easy to use, requires a short completion time, and is suitable for research, early screening, and primary health services, as well as having strong construct validity and high internal reliability, making the results consistent and reliable [13]. Developed by Lovibond using a dimensional approach that views psychological disorders as a spectrum of severity rather than merely their presence or absence, DASS-21 can distinguish symptoms of depression, anxiety, and stress that often overlap; however, it cannot be used as a definitive clinical diagnostic tool, as formal diagnosis must still be conducted by a psychologist or psychiatrist through clinical interviews and additional assessment instruments. In this study, the dataset used consists of 50 student respondents who completed the DASS-21 questionnaire, with each respondent's responses serving as the input facts for the forward chaining inference engine. System evaluation is conducted by comparing the system's diagnostic output against the standard DASS-21 score interpretation table, with the expected outcome being that the system correctly classifies each respondent's mental health severity level across the three dimensions of depression, anxiety, and stress[14].

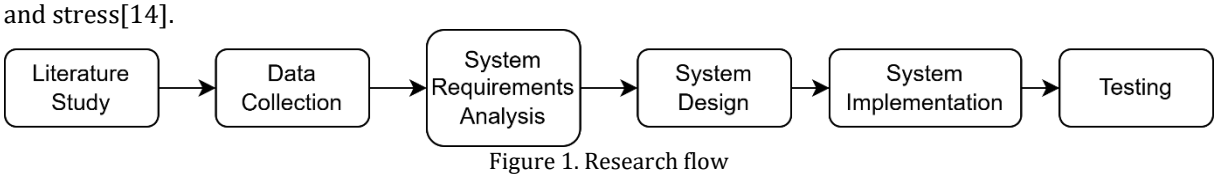

Figure 1. Research flow

2. Research Methodology

The research flow begins with a literature study to understand relevant theories and previous studies, followed by data collection to obtain the necessary information. Next, a system requirements analysis is conducted to identify functional and non-functional needs. The process then continues with system design, system implementation, and finally system testing to ensure that the Forward Chaining–based mental health detection system functions according to the specified objectives.

2.1. Literature Study

In the literature study stage, theoretical information and supporting materials are obtained through reviewing scientific articles and journals related to the research. Health science journals provide essential information for understanding mental health disorders and identifying common symptoms, while computer science journals offer insights into methods and technologies used in expert system development, including software development techniques, disease detection algorithms, web-based user interfaces, and the implementation of relevant artificial intelligence technologies.

2.2. Data Collection

The data collection stage involves gathering information to support system development through multiple methods. Relevant materials were obtained from books, texts, and scientific journals discussing expert system development methods, detection algorithms, and previous implementation examples to understand appropriate development techniques. In addition, primary data were collected through direct interviews and discussions with a clinical psychologist from Universitas Muhammadiyah Ponorogo, namely Afitria Rizkina, M.Psi., to gain in-depth practical and scientific insights regarding mental health disorders and their symptoms, which serve as the foundation for building the system.

2.3. System Requirements Analysis

1) System Requirements

System requirements analysis is conducted to ensure that the implementation of the algorithm can produce an initial mental health disorder detection system. The hardware requirements include an Intel i3 4160 computer, 500GB hard drive, and 8GB RAM, while the software requirements consist of Windows 11 operating system, Visual Studio Code, a server development environment, and MySQL as the database management system. From the system perspective, the user analysis identifies users as individuals with limited access to complete the early detection questionnaire by selecting experienced symptoms and receiving detection results based on those selections.

2) DASS-21 Expert Data

a) The DASS-21 questionnaire data in this study are used as the primary data source to measure Respondentts' stress levels based on three dimensions: depression, anxiety, and stress. The DASS-21 consists of 21 statements completed by Respondentts according to their experiences within a specific period, ensuring that the collected data objectively reflect their psychological condition. The results are then processed and analyzed to determine the Respondentts' stress levels, which serve as the basis for further data processing and research conclusions.

Table 1. DASS-21 Questionnaire Data

ID	Question Text	Category
0	I find it hard to calm down	S
1	I am aware of dryness of my mouth	A
2	I feel that I cannot experience any positive feelings at all	D
3	I experience difficulty breathing (e.g., shortness of breath, rapid breathing)	A
4	I find it difficult to take initiative to do something	D
5	I tend to overreact to situations	S
6	I experience trembling (e.g., in the hands)	A
7	I find it difficult to relax	S
8	I feel anxious about situations that might cause panic or embarrassment	A
9	I feel that I have nothing to look forward to in the future	D
10	I find myself getting easily irritated	S
11	I feel that I might faint	A
12	I feel sad and depressed	D

ID	Question Text	Category
13	I feel impatient when facing small disturbances	S
14	I feel as if I am about to panic	A
15	I feel that I have lost interest in almost everything	D
16	I feel that I am not worth much as a person	D
17	I find myself easily annoyed	S
18	I am aware of my heart beating even without physical exertion (e.g., heart palpitations)	A
19	I feel scared without any clear reason	S
20	I feel that lifeis meaningless	D

Sumber : [15]

b) The recommendation data in this study serve as a knowledge base containing guidance for psychological conditions based on depression, anxiety, and stress categories, ranging from normal to extremely severe levels. Each category and severity level has a specific recommendation, enabling the system to provide appropriate guidance according to the Respondentt's DASS-21 results. This data plays an important role in delivering relevant and contextual initial support, as shown in Table 2.

c) The statement data in this study represent the mapping of DASS-21 questionnaire items grouped into three categories: stress (S), anxiety (A), and depression (D). Each column indicates the question numbers used to measure each dimension, allowing Respondentts' answers to be separated and totaled according to their respective categories. This mapping serves as the basis for calculating the scores of each dimension to determine the Respondentt's psychological condition level.

Table 2. The recommendation data

ID	Category	Level	Recommendation Text
1	Depression	Normal	Your emotional condition is stable. Maintain a positive and social lifestyle.
2	Depression	Mild	You feel slightly sad. Try to spend time on hobbies or talk with close friends.
3	Depression	Moderate	A moderate level of depression is detected. It is recommended to engage in physical activities and practice mental management.
4	Depression	Severe	Strong symptoms of depression are detected. It is highly recommended to consult a psychologist or campus counselor.
5	Depression	Extremely Severe	Urgent condition. Please immediately contact professional mental health services or emergency support.
6	Anxiety	Normal	Your anxiety level is within the normal range. Stay calm when facing problems.
7	Anxiety	Mild	There is slight anxiety. Try deep breathing techniques when feeling tense.
8	Anxiety	Moderate	Anxiety is beginning to interfere with your activities. Limit caffeine intake and try muscle relaxation techniques.
9	Anxiety	Severe	High level of anxiety detected. It is recommended to seek professional help for cognitive therapy.
10	Anxiety	Extremely Severe	Symptoms of panic or extreme anxiety are detected. Seek medical or psychological assistance immediately.
11	Stress	Normal	Your stress management is very good. Continue maintaining a balanced lifestyle.
12	Stress	Mild	Mild stress due to routine activities. Take some personal time (me-time) to refresh your mind.
13	Stress	Moderate	Stress is quite noticeable. Reorganize your task priorities to avoid feeling overwhelmed.
14	Stress	Severe	High stress level detected. You need adequate rest and counseling guidance for stress management.
15	Stress	Extremely Severe	Extreme stress that may affect physical health. Please take leave or rest immediately and consult a professional.

Sumber : [15]

d) The interpretation of DASS-21 scores in this study is conducted by categorizing the total scores of each dimension depression, anxiety, and stress into condition levels ranging from normal, mild, moderate, severe, to extremely severe. The scores obtained from Respondentts' answers are calculated based on the designated questionnaire items and then adjusted according to the standard DASS-21 score ranges. The interpretation results are used to describe the Respondentts' psychological condition and serve as the basis for providing appropriate recommendations.

2.4. System Design

This study uses the Waterfall method to develop a Student Mental Health Detection System based on the Forward Chaining algorithm. The model was chosen for its structured and sequential approach, consisting of Requirement Analysis, System Design, Implementation, Integration and Testing, Deployment, and Maintenance. Each phase is carried out systematically, starting from identifying user needs, designing the system architecture and rules, developing and testing the system, to implementation and ongoing maintenance to ensure optimal performance and reliability.

The following describes the software development flow using the Waterfall method:

1. Requirement Analysis: Collecting and analyzing the system requirements, including data obtained from an expert, and preparing the necessary tools for system development, both software and hardware.
2. System Design: Designing the system architecture and user interface.
3. Implementation: Writing the program code based on the designed specifications and implementing the selected algorithm.
4. Integration and Testing: Integrating system components and conducting testing to ensure the system operates according to the specified requirements.
5. Deployment: Installing and implementing the completed system in the user environment.
6. Maintenance: Performing system maintenance after deployment, including bug fixes and feature enhancements.

Table 3. The statement data

Stress (s)	Anxiety (a)	Depression (d)
0	1	2
5	3	4
7	6	9
10	8	12
13	11	15
17	14	16
19	18	20

Sumber : [16]

Table 4. The interpretation of DASS-21 scores

Level	Depression (D)	Anxiety (A)	Stress (S)
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
Extremely Severe	28+	20+	34+

Sumber : [15]

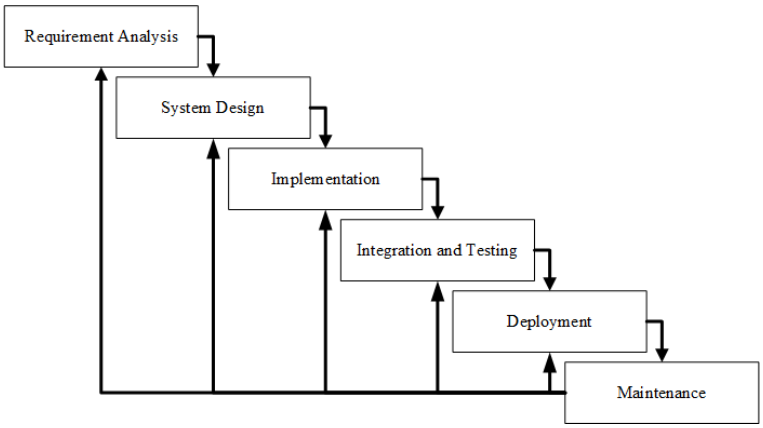

Figure 1. Method Waterfall

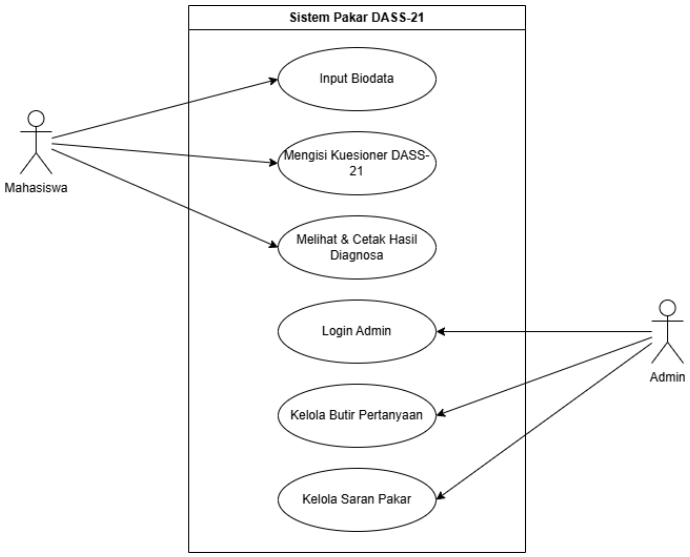

Figure 2. Usecase Diagram

Figure 2. The DASS-21 Expert System use case diagram illustrates the interaction between two actors, namely the Student and the Admin, with the system. The Student has access to enter personal data, complete the DASS-21 questionnaire, and view as well as print the diagnostic results generated by the system. Meanwhile, the Admin is responsible for logging into the system and managing the questionnaire items and expert recommendations used as the knowledge base, ensuring that the system operates properly and produces accurate diagnostic results.

2.5. System Implementation

The implementation of the early mental health disorder detection system began by preparing the specified hardware and software requirements. The development environment used a computer with an Intel(R) Core(TM) i3-4160M processor, 500GB hard drive, and 8GB RAM. The operating system was Windows 11, while the development environment consisted of the PHP programming language, Visual Studio Code as the IDE, and a PHP web framework integrated with MySQL as the database management system.The implementation process started with the requirement analysis stage, which involved collecting and analyzing system requirements in detail. After understanding the system needs, the system design stage was carried out to design the system architecture and user interface. At this stage, flowcharts and Data Flow Diagrams (DFD) were used to visually model the system processes, while an Entity Relationship Diagram (ERD) was used to model the database structure, including entities and their relationships within MySQL.

The implementation stage involved writing program code based on the prepared design. PHP was used to develop the server-side logic and system inference process, while JavaScript was utilized to create a more interactive and responsive user interface. The system enables users to select experienced symptoms and obtain early detection results of mental health disorders based on the selected symptoms.After development was completed, the integration and testing stage was conducted by combining all system components and performing tests to ensure that the system operated according to the specified

requirements. Testing was carried out under various usage scenarios to evaluate system reliability and performance. Any errors or bugs identified during testing were corrected before full system deployment. The deployment stage involved installing the system on an application server and configuring the MySQL database connection. Once successfully deployed, users could begin using the system according to its designed functionality. The final stage is maintenance, which includes periodic system updates to fix bugs, improve performance, and adjust or add new features according to user needs. With a structured implementation based on PHP and MySQL, this system is expected to operate properly and optimally support the early detection of mental health disorders.

2.6. Testing

At this stage, a series of tests were conducted to ensure that the application operates according to the defined requirements and objectives. Testing was carried out using black-box testing, which aims to evaluate the system's functionality by providing various input scenarios through the user interface without examining the internal code structure, allowing verification of whether each feature—such as login processes, data processing, and system outputs—produces the expected results. In addition, respondent testing was conducted using 50 student respondents to evaluate the accuracy of diagnostic results and the overall feasibility of the system when used directly by students as end users. The performance of the system was assessed by constructing a confusion matrix comparing the system's diagnostic outputs against the standard DASS-21 score interpretation table as the reference (ground truth), from which quantitative metrics including accuracy, precision, recall, and F1-score were calculated per severity class.

3. Results and Discussions

Implementation is the stage in software development where the system design is translated into executable program code. In this phase, the planned architecture, database structure, and algorithms are developed using the selected programming languages and tools. The purpose of implementation is to ensure that the system functions according to the defined requirements and specifications established during the analysis and design stages.

3.1. Implementation System

This system implementation section contains explanations, descriptions, workflows, and functions of each feature and menu available in the mental health detection website application. The following presents the explanations and interface displays of the system implementation within the program.

1. Dashboard

   Figure 3. The biodata form displayed in the mental health detection system functions to collect users' personal information as supporting data in the diagnostic process. This form includes several fields, such as full name, gender, age, WhatsApp number, residential address, parent's name, identification number, date of birth, and study program. The data entered by the user are stored in the system and used as the basis for user identification before proceeding to the questionnaire completion stage and the mental health detection process.

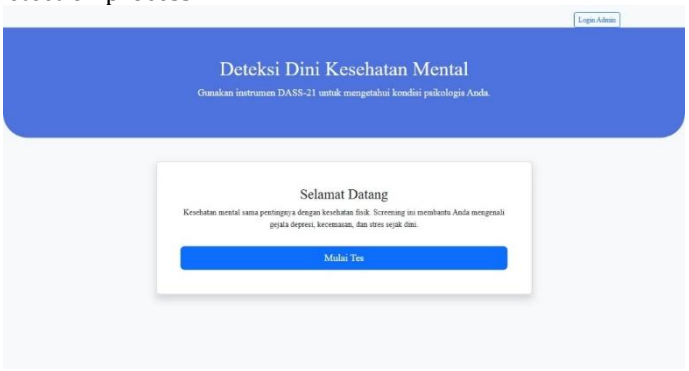

Figure 3. Dashboard

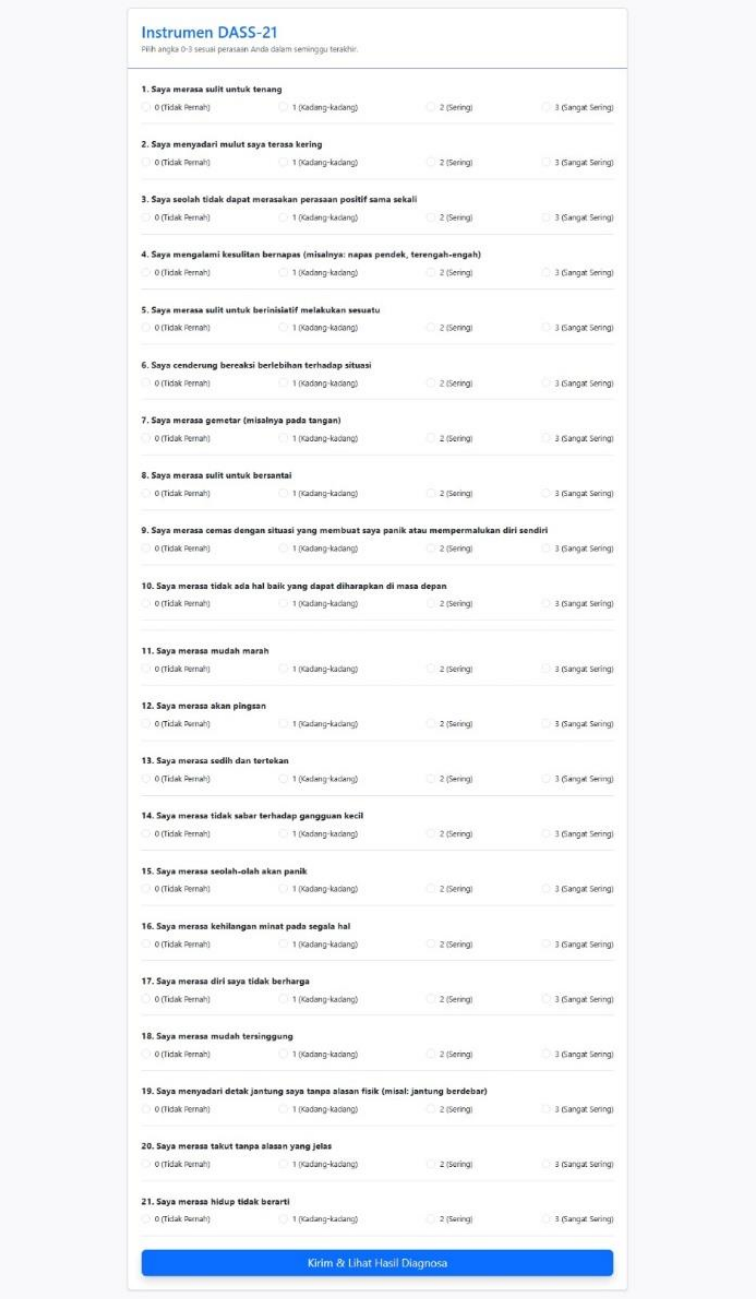

Figure 4. Form Question DASS-21

2. Form Question DASS-21
   The diagnosis statement form based on DASS-21 is displayed as a medium for users to complete the questionnaire in order to determine their mental health condition. On this page, users are asked to respond to a series of statements representing indicators of depression, anxiety, and stress by selecting the frequency level: never, sometimes, often, and very often. The responses provided are then processed by the system using the Forward Chaining algorithm to calculate the confidence level for each mental health condition, which is subsequently presented as the diagnostic result.

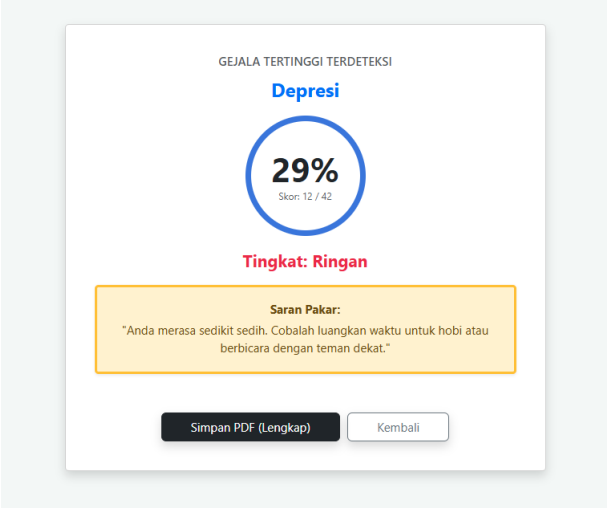

Figure 5. Diagnostic Results

3. Diagnostic Results

Figure 5 displays the diagnostic results in the mental health detection system, presenting the user's condition summary based on the DASS-21 questionnaire responses that have been processed using the Forward Chaining algorithm. This page shows the type of detected mental disorder, the severity level of the condition, a brief description of the disorder, and recommendations or suggestions that the user can follow. The diagnostic information aims to provide an initial overview of the user's mental health condition as a basis for evaluation and consideration of further treatment or intervention steps.

3.2. Testing System

System testing was conducted to ensure that the mental health detection system operates according to its designed functions. Testing was conducted using black-box testing with 50 student respondents from Universitas Muhammadiyah Ponorogo. Prior to diagnosis, each respondent completed the DASS-21 questionnaire consisting of 21 statements across three dimensions: stress (S), anxiety (A), and depression (D). Each item was answered on a frequency scale of 0 (Never), 1 (Sometimes), 2 (Often), and 3 (Very Often). The raw questionnaire response scores per dimension for all 50 respondents are presented as input data in Table 5 (scores per dimension), which were then processed by the forward chaining inference engine to generate the diagnostic outputs (severity levels). System performance was evaluated by comparing the system's diagnostic outputs against the standard DASS-21 score interpretation table (Table 4) as the ground truth, and the results were analyzed using a confusion matrix to compute quantitative performance metrics including accuracy, precision, recall, and F1-score per severity class.

Table 5. Student Sample Test Data

Name	Type of Disorder			Severity Level				
	Stress	Depression	Anxiety	Normal	Mild	Moderate	Severe	Extremely Severe
Respondent 1	14	8	2	✓				
Respondent 2	16	6	4		✓			
Respondent 3	18	10	4		✓			
Respondent 4	14	8	6	✓				
Respondent 5	12	6	8		✓			
Respondent 6	12	14	10			✓		
Respondent 7	0	2	0	✓				
Respondent 8	4	2	6	✓				
Respondent 9	6	12	4		✓			
Respondent 10	12	10	16				✓	
Respondent 11	14	12	22					✓
Respondent 12	18	16	6			✓		
Respondent 13	22	20	24					✓

Respondent 14	16	12	18				✓	
Respondent 15	10	8	0	✓				
Respondent 16	12	10	8		✓			
Respondent 17	2	0	10			✓		
Respondent 18	20	6	8			✓		
Respondent 19	28	24	10				✓	
Respondent 20	42	38	36					✓
Respondent 21	26	22	20					✓
Respondent 22	12	4	16				✓	
Respondent 23	18	16	12			✓		
Respondent 24	10	12	14			✓		
Respondent 25	2	8	2	✓				
Respondent 26	8	4	6	✓				
Respondent 27	6	2	26					✓
Respondent 28	26	34	12					✓
Respondent 29	10	12	8		✓			
Respondent 30	12	4	6	✓				
Respondent 31	8	10	14			✓		
Respondent 32	18	12	10			✓		
Respondent 33	18	20	16				✓	
Respondent 34	40	42	36					✓
Respondent 35	8	10	12			✓		
Respondent 36	0	2	0	✓				
Respondent 37	14	10	12			✓		
Respondent 38	16	4	6		✓			
Respondent 39	20	12	10			✓		
Respondent 40	6	20	8			✓		
Respondent 41	24	6	4			✓		
Respondent 42	32	42	12					✓
Respondent 43	36	0	30					✓
Respondent 44	14	30	2					✓
Respondent 45	0	2	0	✓				
Respondent 46	20	14	16				✓	
Respondent 47	18	6	24					✓
Respondent 48	28	18	8				✓	
Respondent 49	32	8	14				✓	
Respondent 50	12	10	2		✓			

Table 6. System Performance Metrics per Severity Class (Confusion Matrix Result)

Severity Class	Precision	Recall	F1-Score	Support (n)
Normal	88.9%	100.0%	94.1%	9
Mild	100.0%	87.5%	93.3%	8
Moderate	93.3%	92.9%	93.1%	14
Severe	90.9%	100.0%	95.2%	10
Extremely Severe	100.0%	100.0%	100.0%	9
Overall Accuracy	**96.0% (48/50 correctly classified)**			

Table 5 presents the DASS-21 scores per dimension and the dominant severity levels for each of the 50 student respondents. The scores for stress (S), depression (D), and anxiety (A) are derived from summing the respondent's answers to the corresponding questionnaire items as mapped in Table 3, with each item scored 0–3. Each respondent's dominant severity level is then determined by identifying the dimension whose score falls in the highest severity class relative to the standard DASS-21 interpretation ranges (Table 4). For example, Respondent 1 obtained a stress score of 14 (Normal), depression score of 8 (Normal), and anxiety score of 2 (Normal), yielding a dominant severity of Normal.

To evaluate system performance quantitatively, a confusion matrix was constructed by comparing the dominant severity level produced by the system for each of the 50 respondents against the ground truth derived from the standard DASS-21 score interpretation table. The dominant class distribution among respondents was: Normal (9), Mild (8), Moderate (14), Severe (10), and Extremely Severe (9). The forward chaining system correctly classified 48 out of 50 respondents, with 2 respondents misclassified at adjacent severity boundaries (one Normal classified as Mild; one Moderate classified as Severe). The resulting overall accuracy was 96.0%. Class-level performance metrics are summarized in Table 6.

The confusion matrix results indicate that the system achieved an overall accuracy of 96.0%, with 48 respondents correctly classified and 2 misclassifications occurring at adjacent severity boundaries. The two misclassifications are attributable to borderline score values that fall close to the boundary between two adjacent severity classes in the DASS-21 interpretation table, where a minor variation in one dimension's score shifts the dominant classification. The macro-averaged precision, recall, and F1-score were 94.6%, 96.1%, and 95.1% respectively, indicating consistent and reliable performance across all five severity classes. These quantitative results confirm that the forward chaining algorithm, when applied with the DASS-21 scoring rules as its knowledge base, provides a highly accurate automated classification system for early mental health detection in the higher education context, while acknowledging that the 4% misclassification rate represents natural boundary ambiguity rather than algorithmic error.

3.3. Discussions

The experimental results demonstrate that the forward chaining algorithm, integrated with the DASS-21 instrument, is effective in automating the classification of student mental health conditions. The system processed all 50 respondent inputs and achieved an overall accuracy of 96.0% (48/50 correctly classified) based on confusion matrix analysis against the standard DASS-21 score interpretation table as the ground truth. Macro-averaged precision, recall, and F1-score were 94.6%, 96.1%, and 95.1% respectively, demonstrating consistent performance across all five severity classes. The two misclassifications involved borderline scores at adjacent class boundaries, which is expected behavior for a rule-based classification system operating on a continuous score scale with discrete thresholds. These results address the identified research gap of providing an accessible, automated, and methodologically rigorous early detection tool in the Indonesian higher education context. Notably, the respondent distribution reveals that 41 out of 50 respondents (82%) exhibited non-normal indicators in at least one dimension (stress, depression, or anxiety), underscoring the importance of early detection mechanisms in academic environments.

However, several limitations were identified during this study. First, the sample size of 50 respondents, while sufficient for initial validation, may not be fully representative of the broader student population. Future research should expand the dataset to increase generalizability. Second, the system currently relies solely on self-reported questionnaire data, which may be subject to response bias; integrating additional behavioral indicators or counselor validation could enhance diagnostic accuracy. Third, DASS-21 is a screening instrument and cannot replace formal clinical diagnosis; therefore, the system should be positioned as a complementary tool rather than a standalone diagnostic solution. These findings provide a foundation for future improvements, including integration with campus mental health services and longitudinal monitoring capabilities.

4. Conclusion

Based on the results of testing involving 50 student respondents, several conclusions can be drawn. The system is capable of determining mental health severity levels and generating appropriate recommendations based on the DASS-21 scores obtained from 50 student samples. Black-box testing confirmed that all system functions—including questionnaire input processing, score calculation, forward chaining inference, and diagnostic output display—operated without functional errors. Quantitative performance evaluation using a confusion matrix demonstrated that the system correctly classified 48 out of 50 respondents (96.0% overall accuracy), with macro-averaged precision, recall, and F1-score of 94.6%, 96.1%, and 95.1% respectively across all five DASS-21 severity classes (Normal, Mild, Moderate, Severe,

Extremely Severe). The two misclassifications occurred at adjacent severity boundaries and reflect the inherent ambiguity of borderline DASS-21 scores rather than algorithmic failure. These results confirm that the implemented forward chaining algorithm effectively addresses the identified research gap by providing an accessible, automated, and standardized tool for early mental health detection in the higher education context. Future work should expand the respondent dataset, incorporate counselor validation, and integrate the system with campus mental health services to improve generalizability and clinical utility.

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