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RESEARCH PAPER
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SERAYA: A Mobile App for Mental Health with Personalized Self-Healing Recommendations Based on Psychological Assessment

Enggi Wira Praja Putri Taufani, and Umar Zaky
Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Yogyakarta, Indonesia

ABSTRACT

Mental health disorders are a crucial public health issue in Indonesia, as reflected in the 2023 National Health Survey (SKI), which reported that 2.0% of the population aged ≥15 years old were diagnosed with mental health problems, and approximately 20% of the 250 million people experiencing mental health problems do not yet have access to adequate services. Although many previous studies have developed digital applications, such as "Serenity" and "CERDAS" in Indonesia for psychological assessment using instruments such as the DASS-21, these applications only provide general recommendations and do not provide personalized self-healing guidance. To address this gap, this study developed and tested "SERAYA", a mobile application designed not only to assess mental health levels but also to provide self-healing recommendations. This application integrates two standard instruments, the DASS-21 and the PSS-10, to measure depression, anxiety, stress, and perceived stress. A rule-based expert system using forward chaining processes the assessment scores; for example, "IF DASS-21 depression score ≥ 28 THEN recommendation = 'CBT Therapy'". Based on this score, the system generates specific recommendations or direct referrals to mental health professionals for severe cases. SERAYA's functionality was verified through successful black-box testing. Initial usability assessments using the System Usability Scale (SUS) with 11 respondents yielded an average score of 80.68, indicating good usability and ease of learning for early users. While these initial results are encouraging, they are derived from a limited, non-clinical sample and cannot be generalized to the entire Indonesian population. Overall, this study demonstrates that "SERAYA" serves as a viable proof-of-concept for providing personalized early mental health support and illustrates the potential of rule-based systems in digital health applications. Future research should focus on larger-scale validation, clinical integration for professional referrals, and the application of machine learning techniques to enable dynamic and tailored personalization.

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CONTACT:

enggiwira.if@gmail.com
umarzaky@uty.ac.id

I. INTRODUCTION

Mental health is now a global issue that is receiving increasing attention, especially since the COVID-19 pandemic [1]. This urgency is reflected in the Sustainable Development Goals (SDGs) of the United Nations (UN), particularly target 3.4, which emphasizes the importance of promoting mental health and well-being [2]. The increasing urgency of this problem is also reflected in the high prevalence of psychological symptoms in Indonesia. The 2023 Indonesian Health Survey (SKI) highlighted the situation at the national level, with 2.0% of the population aged ≥15 years old diagnosed with mental health problems [3] and around 20% of Indonesia's 250 million people with mental disorders still do not have access to adequate mental health services at the provincial level [4]. The high prevalence of mental health disorders has the potential to reduce public well-being and hinder the achievement of the SDGs in Indonesia [5]. Mental health awareness remains low in many low- and middle-income countries, reflected in limited screening, referral, and treatment services, including in Indonesia [6]. In addition, it is estimated that low- and middle-income countries will bear approximately 35% of the total costs related to mental health problems [7]. In this context, internet-based services can reduce barriers to care related to cost, transportation, service availability, waiting times, and stigma, thereby helping to reduce disparities in access to mental health services [8].

Three common psychological symptoms are depression, anxiety, and stress [9], which often stem from a failure to manage emotions healthily. This ability is greatly influenced by emotion beliefs, which refer to an individual's convictions regarding the nature, meaning, and utility of emotions [10],[11]. For example, when a

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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person feels that others expect them not to feel negative emotions, they tend to experience more negative meta-emotions and poorer psychological health [12]. Failure to manage emotions and the emergence of negative meta-emotions are very relevant to students who experience academic burnout, which reflects a negative psychological attitude towards academics, reduces life satisfaction and learning effectiveness, and triggers anxiety, depression, and affects daily behavior [13],[14]. If not treated early, this disorder can develop into a heavier psychological burden, as well as disrupt daily functioning, reduce productivity, and increase the burden of health costs [15],[16]. This can even lead to very serious consequences, namely suicide, which is ranked as the fourth leading cause of death in individuals aged 15–29 years, especially among students [17].

Mobile health technology (mHealth) has the potential to be a solution to expand access to more affordable health services, thereby helping to overcome limitations in health services [18]. For example, the use of an artificial intelligence-based questionnaire application can support continuous symptom monitoring, which can then be used to support the treatment process [19]. Each application has a different intervention model, and users can utilize it according to their needs, such as interventions for self-help [20], IM-CBT (Internet-based and mobile-based Cognitive Behavioral Therapy) [21], or for self-management [22]. Previous research has concluded that although mobile app-based mental health interventions are not intended to replace face-to-face consultations, they are still cost-effective and highly accessible to individuals in need [16]. The potential of mental health apps to improve the monitoring and management of mental disorders is increasingly recognized, with research showing that interventions via mobile apps are effective in reducing symptoms of depression, anxiety, and stress [23]. In Indonesia, previous research has also recommended application-based innovations for screening and diagnosing mental health disorders by utilizing technology to provide accessible, practical, and user-friendly solutions to increase public awareness and knowledge about the importance of mental health [24]. Indonesia is also utilizing this technology to expand access to services and encourage the development of early detection tools that are relevant to the digital generation [25], [26].

Digital applications to support mental health have also been developed in Indonesia by previous research. For example, Hidayati et al. (2024) developed a web-based application named “Serenity”, which utilizes the DASS-21 questionnaire along with the Forward Chaining inference method to detect and classify symptoms of depression, anxiety, and stress [27]. Similarly, Septiana et al. (2025) developed the CERDAS application, a website-based tool that adopts a single instrument, the DASS-21, for early screening of adolescent mental health problems such as depression, anxiety, and stress [28]. Despite these studies demonstrating the feasibility and clinical benefits of using digital apps, most are limited to symptom detection or providing general recommendations without personalized interventions. In fact, personalization is considered a key factor in effectively supporting mental health because it allows services to be tailored to individual conditions [29]. To date, there is no application in Indonesia that integrates two validated instruments (DASS-21 and PSS-10) with a rule-based personalized self-healing recommendation system, thus creating a significant gap in meeting the growing mental health needs in the country. This presents an opportunity to develop a digital solution that not only detects symptoms of depression, anxiety, and stress early but also offers tailored self-healing interventions tailored to the user's condition through psychological assessments.

Based on the identified gaps, the primary aim of this study is to develop and test a mobile app “SERAYA” that integrates the DASS-21 and PSS-10 instruments to provide personalized self-healing recommendations through a rule-based system, and evaluate its usability. The main contributions of this study are: (1) Integrating the DASS-21 and PSS-10 instruments for psychological assessment; (2) Implementing a rule-based system that generates personalized self-healing recommendations based on assessment results; (3) Initial validation of the application’s usability through user testing. Thus, the resulting mobile application can support early screening and provide free services, encourage self-monitoring and prevention, and reduce barriers to accessing mental health services in Indonesia.

II. MATERIAL AND METHODS

A. Research Framework

The method used as a framework for this research is Design Research Methodology (DRM) [30]. DRM provides a systematic framework for all stages of design research, starting from literature, research plan development, to implementation. DRM is a research approach that aims to develop and validate knowledge in a structured manner in the context of engineering design [31]. This method consists of four main stages, namely Research Clarification, Descriptive Study I, Prescriptive Study, and Descriptive Study II [32]. These stages are depicted visually in **Fig. 1**, which shows the research flow applied in developing this application. It should be noted that in this study, DRM was applied in an application developer environment, with a focus on the internal development, testing, and evaluation process structure.

1. Research Clarification

In the Research Clarification (RC) stage, the primary focus is on identifying and clarifying the problem underlying the application development. This stage aims to understand the urgency of the research and identify the research gap between existing conditions and needed solutions. In the context of this research, RC was conducted through literature analysis and surveys related to mental health issues, both globally and in Indonesia, with an emphasis on psychological symptoms such as stress, anxiety, and depression. The findings from this stage highlight the need for digital solutions capable of early detection of psychological symptoms through

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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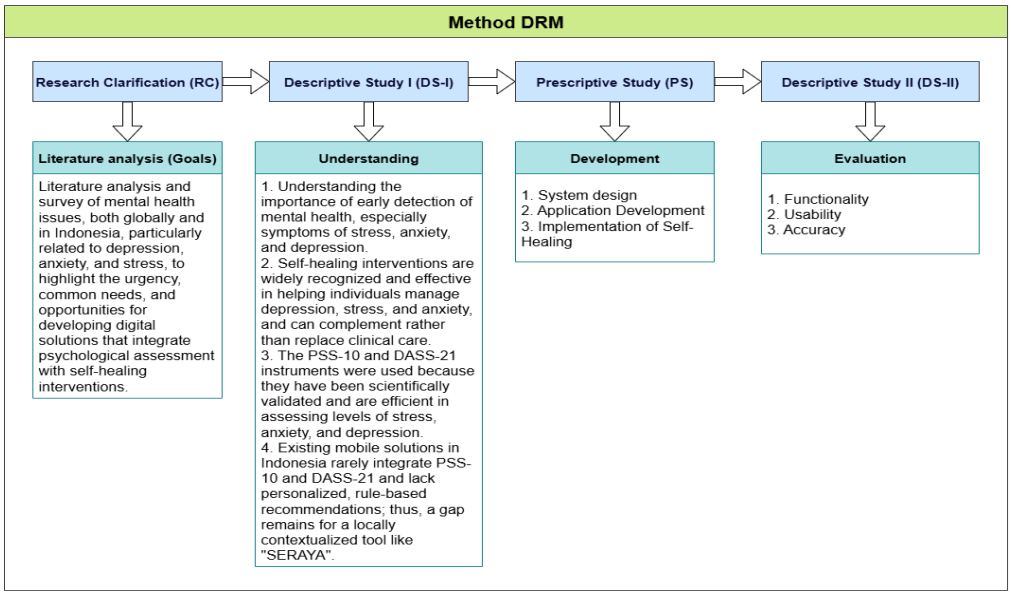

Fig. 1. Design Research Methodology (DRM) Research Framework

standardized instruments such as the Perceived Stress Scale (PSS-10) and the Depression Anxiety Stress Scale (DASS-21).

2. Descriptive Study I

This Descriptive Study I (DS-I) stage was conducted to review relevant literature, theories, and empirical findings to build a conceptual foundation for solution development. In this study, the DS-I phase included an understanding of the importance of early detection of mental health symptoms, particularly stress, anxiety, and depression, as well as a review of scientific evidence regarding the effectiveness of self-healing interventions, and how digital applications can assist in mental health well-being. Furthermore, this stage also emphasized the rationale for using the PSS-10 and the DASS-21, as both have been proven scientifically valid and effective in measuring levels of stress, anxiety, and depression. This analysis also revealed that digital solutions rarely integrate these two instruments and do not yet provide personalized, rule-based self-healing recommendations, reinforcing the urgency of developing the “SERAYA” mobile app.

3. Prescriptive Study

In the Prescriptive Study (PS) stage, the research focuses on developing conceptual solutions that can address the problems identified in the previous stage. First, a system design was conducted, outlining the application’s workflow, including how user assessment data from the PSS-10 and DASS-21 instruments are processed to generate information on stress, anxiety, and depression levels. This stage also includes system implementation, where the design is translated into a functional mobile app integrated with assessment instruments and self-healing recommendations. The tools used in the design and development of the application are summarized in **Table1**. These tools include not only the software used for implementation, but also tools that supported interface design and system architecture modeling.

Table 1. Application Development Software

Component	Tools
UI/UX Design	Figma
System Architecture	Draw.io
Framework	Flutter (v3.24.4)
Programming Language	Dart (v3.5.4)
Backend	Firebase (Auth and Firestore)
Apps Development	Android Studio IDE

4. Descriptive Study II

The results of the Prescriptive Study (PS) were evaluated in the subsequent Descriptive Study II (DS-II) stage, which is the final stage in the DRM framework. This evaluation was conducted in a developer testing environment focusing on three main aspects: functionality, usability, and accuracy. The functional evaluation included examining all application features, including user authentication, completing the PSS-10 and DASS-21 questionnaires, processing assessment scores, providing personalized self-healing recommendations, accessing articles, and the daily journal feature, to ensure everything worked as planned without errors or crashes. Functionality was validated through black-box testing. For example, in the login test, when a user enters a valid email address and password, the system should successfully authenticate and redirect them to the homepage, while invalid credentials should trigger an appropriate error message. Before conducting usability testing by external users, an initial internal usability assessment by the developers was conducted to identify and address potential interface and navigation issues. While this step doesn’t replace the actual user feedback, it provides an opportunity to refine the layout and interaction flow before a formal usability evaluation with external users. Accuracy

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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was evaluated by randomly inputting questionnaires on the PSS-10 and DASS-21 instruments, then checking whether the system-computed scores matched the manual scores (original scores) for both instruments. To ensure reliability, over 30 pre-scored dummy responses were run through the system, and the resulting scores and recommendations were verified to be consistent with the manual calculations and coded recommendation rules.

B. Research Instrument

The research instrument used in developing the "SERAYA" mobile app integrates the Depression Anxiety Stress Scale-21 (DASS-21) and the Perceived Stress Scale-10 (PSS-10). The selection of DASS-21 and PSS-10 as core instruments has its own urgency given their complementary nature, especially in assessing stress symptoms. The Depression Anxiety Stress Scale (DASS-21), developed by Lovibond and Lovibond (1995), is the official shortened form of the DASS-42. The DASS-21 consists of 21 items designed to shorten the completion time without reducing the quality of the measurement experienced by respondents in the last week[33], [34], [35]. This scale is divided into three subscales, namely depression, anxiety, and stress, each consisting of 7 questions, so that the total is 21 items [36]. The stress subscale on the DASS-21 assesses responses to nonspecific chronic stimuli, such as difficulty relaxing, restlessness, irritability, overreactivity, and impatience [37]. Meanwhile, the Perceived Stress Scale (PSS), originally developed by Cohen et al. and later simplified into a 10-item version (PSS-10), assesses an individual's subjective perception of stress, including thoughts and feelings experienced over the past month [38], [39].

The Indonesian version of the DASS-21 instrument has been translated and systematically classified per aspects in previous research by Hakim et al., (2023) [40]. The items are labeled D1–D7 for depression, A1–A7 for anxiety, and S1–S7 for stress. It contains 21 questions divided into three main aspects: depression, anxiety, and stress [34]. The DASS-21 scale uses 7 items per aspect rated on a 0–3 Likert scale, namely: (0 = "Did not apply to me at all", 1 = "Applied to me to some degree or some of the time", 2 = "Applied to me to a considerable degree or a good part of the time", and 3 = "Applied to me very much or most of the time"). Depression, anxiety, and stress scores are calculated by summing the scores of the corresponding items. Since the DASS-21 is a shortened version of the DASS-42, the scores for each subscale are multiplied by two to obtain the final score [41]. The scores are then categorized into five levels: Normal, Mild, Moderate, Severe, and Very Severe. This classification is used to facilitate the interpretation of an individual's psychological condition based on three main aspects: depression, anxiety, and stress [42]. Details of the severity categories for each aspect can be seen in the following **Table 2** [43].

Table 2. Classification of Depression, Anxiety, and Stress Severity Levels Based on DASS-21 Scores

Severity Levels	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+

The PSS-10 is a stress assessment instrument consisting of 10 questions with multiple answer choices. The level of stress is recorded using a five-point Likert scale (0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often). This scale is used to report the extent to which circumstances in their lives during the past month felt uncontrollable, unpredictable, and overwhelming. Scores for the four positively phrased items (items 4, 5, 7, and 8) are reversed [44]. Some of these items are formulated positively (e.g., In the last month, how often have you felt that things were going your way?), so a high response to this item actually reflects low stress. Based on the total PSS-10 score, stress levels can be categorized into three levels of severity, as shown in **Table 3** [44].

Table 3. Classification of Stress Levels Based on PSS-10 Scores

Severity Levels	Scores
Low Stress	0 – 13
Moderate Stress	14 – 26
High Stress	27 – 40

C. Data Collection and Processing

In this study, data collection was conducted through various methods to obtain the information needed to develop the application and knowledge base for the rule-based system. The methods used included:

1. Literature Review

Gathering information from books, journal articles, and previous research related to symptoms of stress, anxiety, and depression, as well as appropriate self-healing strategies for these conditions. This data was used to develop rules within the rule-based system so that the application could provide self-healing recommendations.

2. Data Collection Through Questionnaires

Participants completed standardized instruments, namely the PSS-10 and DASS-21, directly within the application. Each participant was assigned a unique ID to maintain anonymity, and no personal data such as names, addresses, or telephone numbers were recorded.

3. User Observation and Interactio

This was conducted to determine how users interact with the application and to help refine the system's features, flows, and rules.

D. Design of The System

Based on the assessment instruments and methods described above, this section presents the design of the

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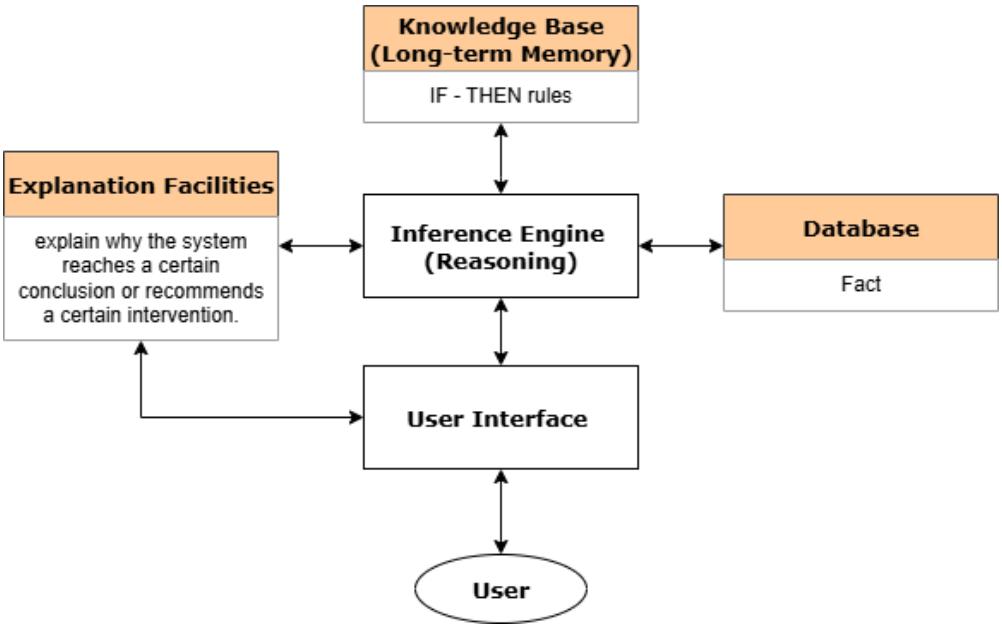

Fig. 2. Rule-Based Expert System Architecture for SERAYA Applications

"SERAYA" mobile app system, which describes how user data is processed to generate personalized self-healing recommendations.

1. Rule-Based Expert System Architecture

The general architecture of the "SERAYA" mobile app recommendation system adopts the standard model of knowledge-based systems, which consists of the main components as shown in **Fig. 2.** This architecture provides a framework on how the parts of the system interact with each other. The knowledge base in the "SERAYA" mobile app system is designed as a repository of inference rules. This component contains a set of "IF-THEN" rules programmed into the system. These rules are divided into three types: (1) interpretation rules to convert scores into categories (e.g., "IF PSS stress score >= 14 THEN category = 'Moderate'"), (2) recommendation rules to link categories to self-healing advice (e.g., "IF category is 'Moderate' THEN recommend 'Take time for me-time'"), and (3) prioritization rules to detect high-risk combinations and provide specific warnings (e.g., "IF high stress AND high depression THEN give priority recommendations").

The Explanation Facilities component explains why users received a certain score by highlighting factors that influenced the results based on questionnaire responses. It also displays severity levels (e.g., low, moderate, high) to help users better understand their condition. Furthermore, the system provides self-healing recommendations based on severity, including a recommendation to seek professional help if the condition is considered very severe. The core component of the system is the inference engine (reasoning), which is the center of reasoning. This engine uses a forward chaining strategy, namely by repeatedly executing rules until there are no more changes in working memory. Working memory itself is a temporary storage that holds all facts and process results during the reasoning session, including: (1) user input data (e.g., questionnaire scores), (2) temporary results in the form of the level or severity of the user's detected condition), and (3) the final output in the form of recommendations.

The database stores initial facts derived from the user or from the system itself. During reasoning, these facts are loaded into working memory and evaluated by the inference engine to determine which rule conditions match. The user interface acts as a link between the user and the system. Through this interface, users enter data (questionnaire scores) and then receive results in the form of condition categories and self-healing recommendations be explained to users through explanation facilities so they understand the system's rationale for making certain decisions. All these components are interconnected. Users interact with the system through the user interface, and data is stored as facts in the database, then processed by the inference engine using rules in the knowledge base. The results of this processing are returned through the user interface, while explanation facilities ensure the results are understandable to users.

2. Inference Workflow

The inference workflow in **Fig. 3** provides a detailed description of the reasoning process, previously only outlined in the block diagram. The process begins with data input, namely the PSS-10 and DASS-21 questionnaire scores entered by the user. The system then calculates the total score for each instrument. The next step is the classification of severity levels based on the scores obtained, including: (1) stress levels from the PSS-10, (2) stress, anxiety, and depression levels from the DASS-21. The results of this classification are then stored in working memory as temporary facts. Next, the

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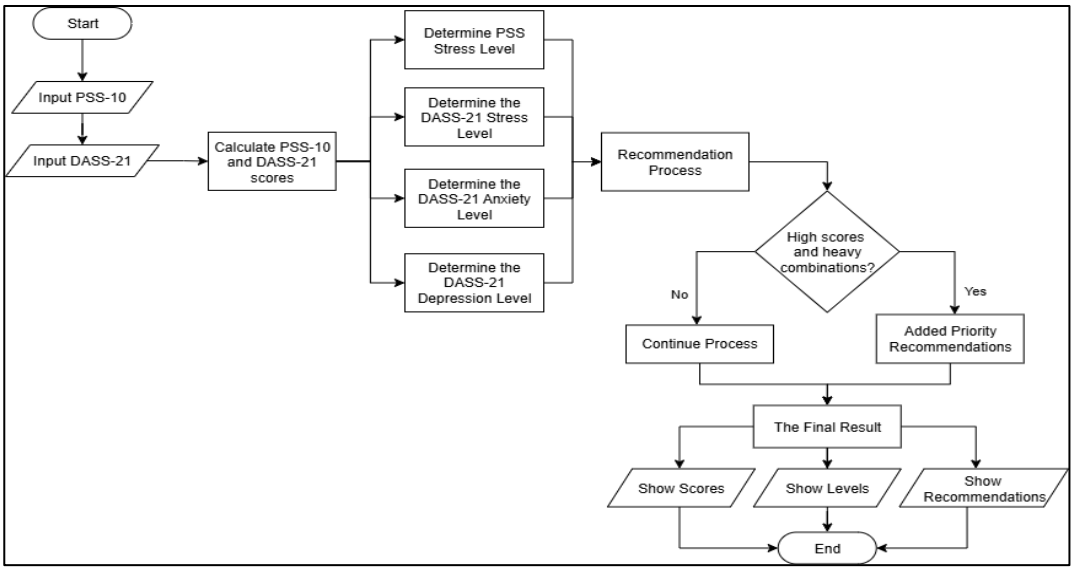

Fig. 3. System Inference Workflow

system enters the recommendation process, where IF-THEN rules are executed to match severity levels with appropriate recommendations. At this stage, a special mechanism is used to detect high-risk combinations, such as high stress combined with severe depression. If these conditions are met, the system adds a priority recommendation, such as seeking immediate professional help. After all the rules are evaluated, the system produces a final output consisting of three main components: (1) the score obtained, (2) the severity of each condition, and (3) personalized recommendations. All these results are displayed through a user interface, accompanied by explanation facilities so that users understand the reasoning behind each conclusion and recommendation provided.

III. RESULTS

A. SERAYA Mobile Application

The "SERAYA" mobile app in **Fig. 4** was successfully developed as an Android-based mobile application that integrates the DASS-21 and PSS-10 psychological instruments. This application is designed to help users identify psychological symptoms such as depression, anxiety, and stress, as well as the level of perceived stress experienced. The "SERAYA" mobile app offers four main, integrated features. First, Self-Assessment, which allows users to complete psychological questionnaires (such as the DASS-21 and PSS-10) to detect levels of stress, anxiety, and depression. The results then form the basis for the second feature, Recommendations. This is where personalization comes in: the system uses a rule-based approach, where each instrument score is mapped to a specific category (e.g., low, medium, high). Based on these categories, the app provides self-healing advice tailored to the user's condition, rather than providing general advice that's the same for everyone. Additionally, the third feature, Educational Articles, provides a variety of relevant educational articles on mental health, managed and uploaded by the admin through the website. Meanwhile, the fourth feature, Daily Journal, helps users keep daily journals and provides daily reflective prompts to help them more easily express their psychological state. Before completing the questionnaire, users are first instructed to practice measured breathing, a structured breathing method with a slowed rhythm. This technique serves as a form of brief relaxation while increasing concentration through a regular breathing protocol, so that users can complete the questionnaire with more focus and calm [45].

The interface is designed using green as the primary color and yellow as the complementary color. Both are considered natural colors and have been experimentally proven to increase visual comfort, reduce anxiety, and lower stress markers like cortisol levels and blood pressure [46]. Green is specifically associated with feelings of calm, confidence, emotional balance, enthusiasm, and peace [47]. Thus, this application functions not only as a measuring tool, but also as a preventive media that supports the continuous improvement of psychological well-being.

B. Rule Implementation

The "SERAYA" mobile application processes user data using a series of predefined logic rules. The core process of the system is converting raw scores obtained from the PSS-10 and DASS-21 questionnaires into severity categories for stress, anxiety, and depression (e.g., Low, Moderate, High). It is important to emphasize that this categorization is intended for screening and self-awareness purposes only and does not replace a professional clinical diagnosis. Based on the results of this categorization, the system generates four or five personalized self-healing recommendations, one or two for each measured psychological domain: perceived stress (PSS), stress, anxiety, and depression (DASS). With this approach, users receive not just one general activity, but a more comprehensive set of

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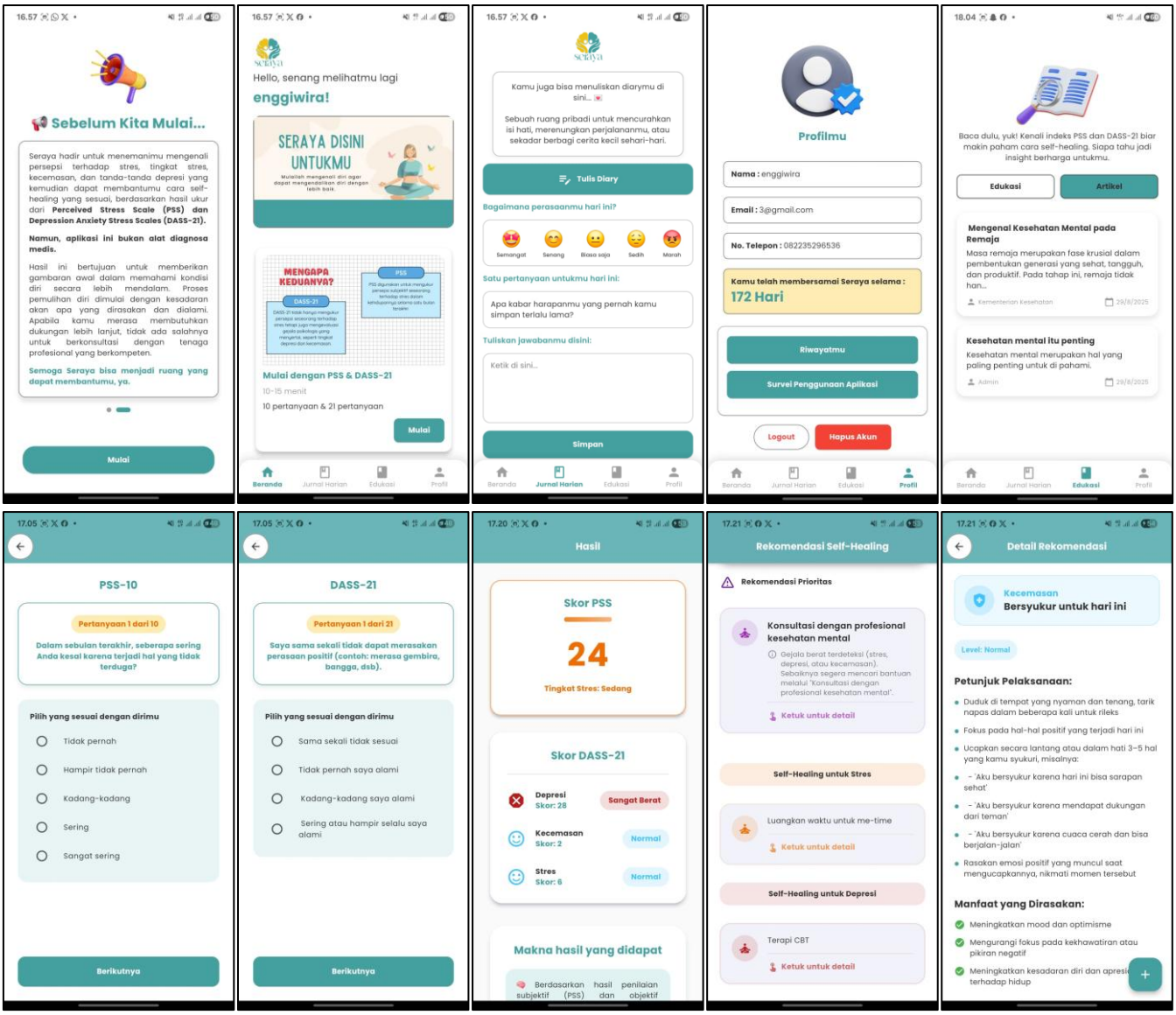

Fig. 4. Application Interface

recommendations tailored to their psychological state across all four domains. Each recommendation refers to strategies that have been reported in the scientific literature as effective and evidence-based. For example, “Positive Self-talk” has been shown to reduce stress, anxiety, and depression in adolescents [48], while the Butterfly Hug intervention has also shown significant effects in reducing anxiety in adolescents [49]. Thus, the recommendations are scientifically sound while remaining easy to understand and implement for lay users .

These outputs are not intended to replace professional diagnosis or treatment, but rather serve as a guide for users in managing their condition. Users can also access a detailed guide within the app, including instructions for use, benefits, and tips for implementing each strategy. The recommendation logic follows the IF-THEN principle, which evaluates the user’s score across each psychological domain. For example, if a user’s anxiety score exceeds a certain threshold, the app will suggest appropriate activities to manage anxiety. This logic is detailed in **Table 4**. For user safety, if a score indicates very severe or severe symptoms in one domain and a combination of high scores across multiple domains, the highest priority recommendation is to immediately contact a mental health professional. While this guideline has not been directly validated by clinical psychologists, it is based on evidence-based self-care principles and commonly recommended practices in psychological support.

C. Testing

Testing is conducted to ensure that all implemented features function as designed. The method used is black-box testing, which focuses on evaluating input and output without examining the internal program code. During testing in the developer environment, no significant issues were found, so all features were deemed functional. However, to ensure the application can be optimally used by a wide range of users, usability testing is required for external feedback. Minor functional issues may still arise

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Table 4. Rule Table

No	Data	IF THEN
1	PSS	IF <= 13 THEN Level = "Low", Recommendation = "Positive Self-Talk"
		IF >= 14 AND <= 26 THEN Level = "Moderate", Recommendation = "Take time for me-time"
		IF >= 27 THEN Level = "High", Recommendation = "Healing with spirituality"
2	DASS (depression)	IF >= 0 AND <= 9 THEN DepressionLevel = "Normal", Recommendation = "Doing a fun hobby"
		IF >= 10 AND <= 13 THEN DepressionLevel = "Mild", Recommendation = "Enjoy healthy and enjoyable food"
		IF >= 14 AND <= 20 THEN DepressionLevel = "Moderate", Recommendation = "Spend time with those closest to you"
		IF >= 21 AND <= 27 THEN DepressionLevel = "Severe", Recommendation = "Practice self-compassion, don't be too hard on yourself."
		IF >= 28 THEN DepressionLevel = "Very Severe", Recommendation = "CBT Therapy"
3	DASS (anxiety)	IF >= 0 AND <= 7 THEN anxietyLevel = "Normal", Recommendation = "Be grateful for today"
		IF >= 8 AND <= 9 THEN AnxietyLevel = "Mild", Recommendation = "Butterfly Hug"
		IF >= 10 AND <= 14 THEN AnxietyLevel = "Moderate", Recommendation = "Guided Imagery"
		IF >= 15 AND <= 19 THEN AnxietyLevel = "Severe", Recommendations = ["Touch Healing", "Listening to Music"]
		IF >= 20 THEN AnxietyLevel = "Very Severe", Recommendation = "Intensive Mindfulness"
4	DASS (stress)	IF >= 0 AND <= 14 THEN stressLevel = "Normal", Recommendation = "Do enjoyable activities regularly"
		IF >= 15 AND <= 18 THEN stressLevel = "Mild", Recommendation = "Mindfulness"
		IF >= 19 AND <= 25 THEN stressLevel = "Moderate", Recommendation = "Yoga"
		IF >= 26 AND <= 33 THEN stressLevel = "Severe", Recommendation = ["Butterfly Hug", "Forgiving Yourself"]
		IF >= 34 THEN stressLevel = "Very Severe", Recommendations = ["Listening to Music", "SEFT Therapy"]
5	Priority recommendations	IF pssLevel = "High" **AND** stressLevel = "Very Severe" **AND** depressionLevel = "Very Severe" **AND** anxietyLevel = "Very Severe" THEN Recommendation = "Consult a mental health professional immediately"
		IF pssLevel = "High" **OR** stressLevel = "Very Severe" **OR** depressionLevel = "Very Severe" **OR** anxietyLevel = "Very Severe" THEN Recommendation = "It is best to seek help from a mental health professional immediately"
		IF pssLevel = "High" **OR** stressLevel = "Severe" **OR** depressionLevel = "Severe" **OR** anxietyLevel = "Severe" THEN Recommendation = "It is recommended to consult a mental health professional immediately"

when the application is used by a wider audience, so continuous feedback from real users is essential. This user-perspective testing is crucial for identifying potential improvements that may not be visible to the developer, thus enhancing the application's quality and user experience. The test results are summarized in **Table 5**, which outlines the test cases, descriptions, initial conditions, scenarios, expected results, and conclusions for each feature.

D. SUS Results of the SERAYA Application

After completing functional testing to ensure all application features are functioning as intended, it's

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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Table 5. Test Application

Test Case	Description	Initial Condition	Scenario	Expected Observation	Conclusion
Register with One-Time Password (OTP)	User registers new account and verifies via OTP	User does not have an account yet	The user enters email, password and data, presses the register button, receives an OTP, then enters the OTP and presses verify	The system validates the OTP and activates the account	Success
Login	User logs into the application	User already has an account	The user enters their email and password, then presses the login button	The system directs the user to the home page	Success
Reset Password	User resets forgotten password	User already has an account	The user selects 'Forgot Passwor'', enters their email, and changes their password via the reset link.	The system updates the password and displays a confirmation	Success
Fill PSS-10 Questionnaire	User fills out the PSS-10 questionnaire	User is logged in	User answers all PSS-10 questions	The system stores the answers and calculates the stress score	Success
Fill DASS-21 Questionnaire	User fills out the DASS-21 questionnaire	User is logged in	User answers all DASS-21 questions	The system stores answers and calculates depression, anxiety, and stress scores.	Success
Recommendations	User sees self-healing recommendations	The user has filled out the questionnaire	User opens the recommendation page	The system displays recommendations according to the questionnaire results.	Success
Journal	User writes or views journal entries	User is logged in	User writes a new note or opens a previous note.	The system stores and displays journal entries.	Success
Articles	User reading mental health article	User is logged in	User selects an article from the list and opens it.	The system displays the contents of the article	Success
View History	User views history	The user has filled out the questionnaire	User opens history page	The system displays all previous history.	Success

important to evaluate the system's usability from the end-user perspective. Functional testing verifies that the application functions correctly under controlled conditions, but it doesn't measure how easy, intuitive, or satisfying the system is for users to interact with. To address this, the System Usability Scale (SUS) is used, which is a standard, fast, and reliable method for assessing user perceptions of an application's ease of use. Using the System Usability Scale (SUS), this evaluation captures direct feedback from users, providing insight into usability issues or potential improvements that might not be detected through functional testing alone. It's important to ensure that the respondents involved are part of the initial testing of the application, so that developers can identify any shortcomings or difficulties with the "SERAYA" mobile app. The SUS questionnaire consists of 10 statements answered on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Five questions are positive (Q1, Q3, Q5, Q7, Q9) and five are negative (Q2, Q4, Q6, Q8, Q10). The total raw score is then multiplied by 2.5 to produce a final SUS score ranging from 0 to 100.

1. Respondents Characteristics

The test involved 11 respondents who voluntarily tried the "SERAYA" mobile app using a convenience sampling method. This number was selected considering time constraints, resources, and access to participants. Furthermore, the ideal number of usability test participants depends on the specific context and

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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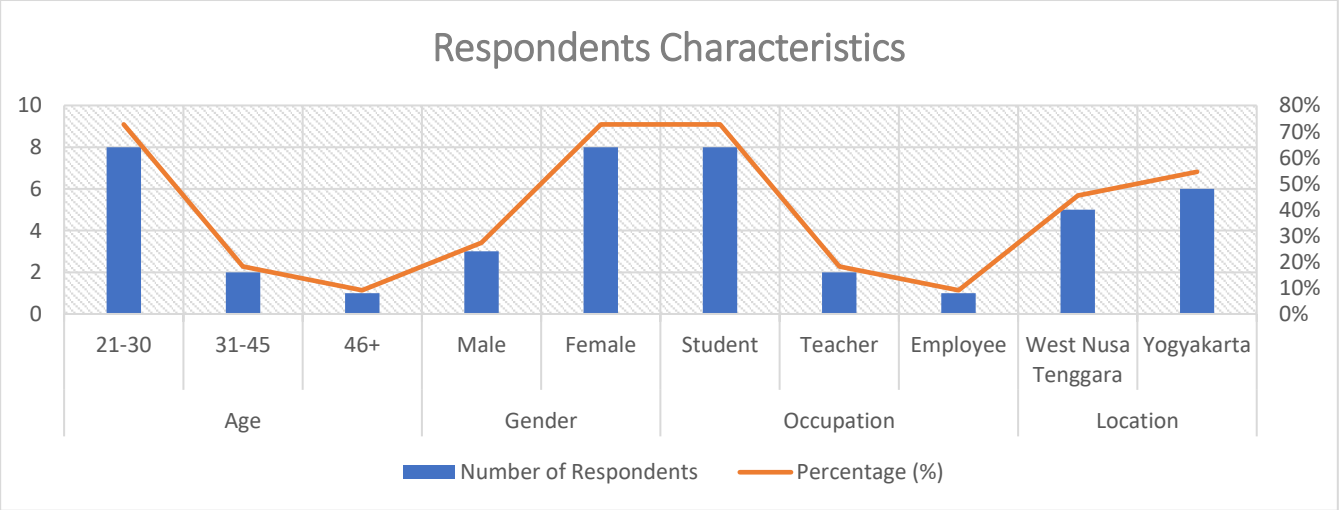

Fig. 5. Characteristics of Respondents in the Usability Test

Table 6. SUS Survey Results

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q 10	Total score (raw data)	Final Score (*2,5)
1	5	1	5	1	4	2	5	2	5	3	35	87.5
2	5	1	4	3	4	3	5	2	3	2	30	75
3	4	2	5	2	4	3	5	2	3	2	30	75
4	5	2	5	3	5	2	5	2	4	2	33	82.5
5	5	2	4	3	4	2	4	3	4	2	29	72.5
6	5	2	5	2	4	2	4	2	4	4	30	75
7	4	2	5	2	4	3	5	2	4	2	31	77.5
8	5	1	5	1	5	1	5	1	5	1	40	100
9	5	1	5	1	4	1	5	1	3	1	37	92.5
10	4	2	4	2	4	2	4	2	4	4	28	70
11	5	2	4	1	4	2	5	1	4	4	32	80
Average Score												80.68

objectives of the test [50]. In this early development stage, the primary goal is to identify potential usability issues and assess the interface's feasibility before conducting more extensive testing. The respondents had diverse characteristics in terms of age, gender, occupation, and region of origin, as shown in **Fig. 5**.

The majority of respondents were aged 21–30 (73%), categorized as young adults and generally active in technology use. A small proportion of respondents were aged 31–45 (18%), and 46 and above (9%), thus maintaining age variation in the sample. In terms of gender, respondents were predominantly female (73%), while only 27% were male. Based on occupation, the majority of respondents were students (73%), followed by teachers (18%), and employees (9%), indicating a diversity of educational and professional backgrounds. Respondents also came from two regions, namely Yogyakarta (55%) and West Nusa Tenggara (45%), with a fairly balanced distribution, so that it was able to represent perspectives from two different regions. This demographic diversity enriched the study by capturing insights from various age groups, genders, occupations, and regional backgrounds, offering a clearer profile of the early users of the "SERAYA" mobile app.

2. Survey Results

Data collection was carried out by distributing the application to respondents, then respondents directly filled out the SUS questionnaire available in the "SERAYA" mobile app. The raw scores and final SUS scores are shown in **Table 6**. The average SUS score of 80.68 indicates that respondents rated the "SERAYA" mobile app as having good and acceptable usability. This indicates that new users can understand and use the app with relative ease on their first try. While the overall rating is positive, some minor improvements could still be made. Analyzing the answers to each SUS indicator, combined with new user interviews, can help identify areas of the app that need improvement, thereby enhancing the overall user experience. And it is important to remember that the SUS-10 does not assess specific features or elements of the system design, but rather provides an overall evaluation of the user experience [51].

3. Qualitative Usability Analysis

Qualitative analysis of usability testing was conducted through interviews. Before the interview, users are given several tasks to use the application. The results of this

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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Table 7. Qualitative Usability Analysis and Respondents' Feedback

Category	Feedback	Recommendations
Learnability	*strengths*	
	The features are mostly easy to understand for young users.	
	weaknesses	
	Elderly users need to learn and familiarize themselves with the application.	Add an initial usage guide for elderly users.
	Some users, especially the elderly, are confused when registering because of the One-Time Password (OTP) feature, so they need to be directed.	Provide a short guide to explain the OTP process during registration.
Efficiency	*strengths*	
	The features are easy to understand, so most users can complete tasks quickly.	
	weaknesses	
	Users have difficulty navigating buttons.	Improve button responsiveness.
Accuracy	*strengths*	
	The features work as intended, and most of them can be used correctly.	
Memorability	*strengths*	
	Some features are easily recognized by users.	
	weaknesses	
	Elderly users have difficulty remembering and recognizing application features.	Improve visual design with contrasting colors and easily recognizable icons for all ages.
Satisfaction	*strengths*	
	Overall, respondents found the app helpful and quite easy to use. One elderly respondent felt the app helped them understand their mental health.	
	weaknesses	
	Language is too heavy for young users <18 years old.	Using simpler language so that the application can be understood by various groups.
	The visual appearance of the application is less attractive, lacking image elements to attract attention.	Improve visual design according to the preferences of various age groups.

qualitative analysis are used as a reference to identify usability issues, including strengths, weaknesses, and recommendations for improvement in the application. **Table 7** presents the qualitative analysis for the "SERAYA" mobile app.

Based on the findings, most features of the app are easy for young users to understand, allowing them to complete tasks quickly and efficiently. However, older users need more time to learn and familiarize themselves with the app. Some elderly users also experienced confusion when registering due to the One-Time Password (OTP) feature, so it is recommended that the app provide a short guide explaining the OTP process to make it easier for them.

In terms of navigation, although most features could be used correctly, some users had difficulty navigating certain buttons. This suggests the need for improvements in button responsiveness and navigation organization to make it more intuitive. In addition, elderly users also have difficulty remembering and recognizing some features, so the visual design needs to be improved with the use of contrasting colors and icons that are easily recognized by all ages.

Overall, users find the "SERAYA" mobile app quite helpful and easy to use. One elderly respondent even stated that the app helps to understand mental health conditions. However, there are some notes regarding the language used, which is considered too heavy if used by users under 18 years old. Therefore, the use of simpler language is highly recommended so that the app can be understood by various age groups.

In addition, the visual appearance of the app can still be improved to make it more appealing, especially to teenage users. The addition of images and design elements that match the preferences of the target users is expected to improve the overall user experience.

The qualitative analysis shows that the "SERAYA" mobile app is easy to use by young users and is quite helpful in understanding mental health conditions. However, some improvements are needed to make it

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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Table 8. Comparison SERAYA With Previous Research

Aspect	SERAYA Mobile App	Serenity	CERDAS App
Primary Purpose	Screening, personalized self-healing recommendations	Early detection of depression, anxiety, stress	Real-time screening of adolescent mental health (depression, anxiety, stress)
Assessment Tools	PSS-10, DASS-21	DASS-21	DASS-21
Delivery Platform	Mobile Application	Web-based	Web-based
Supporting Features	Daily journal, articles for education	Mental health articles	Professional consultation service feature
Consultation feature with professionals	No integrated	No integrated	Yes, integrated (via WhatsApp)
Personalization	Yes, triggers personalized actions based on assessment.	Not explicitly mentioned, but informative suggestions based on results.	Not explicitly mentioned, but informative suggestions based on results.

more understandable for all age groups, so that the overall user experience and usability can be improved.

IV. DISCUSSION

A. Comparison With Previous Research

As explained in the introduction, various digital mental health applications have been developed previously, both in Indonesia and worldwide. These applications in the Indonesian context are shown in **Table 8**, which illustrates that most still have limitations in terms of personalization. In this context, the SERAYA mobile application is presented with a focus on personalization, namely providing recommendations tailored to the user's stress, anxiety, and depression levels based on assessment results using a rule-based system approach.

Compared to other digital mental health apps like "Serenity" [27] and "CERDAS" [28], "SERAYA" demonstrates significant innovative advantages. The "Serenity" application, uses the Forward Chaining with the DASS-21 instrument to classify test results into five levels of depression, anxiety, and stress severity. While this method provides structured categorization, "Serenity" does not offer personalized recommendations or incorporate additional instruments such as perceived stress measures. Similarly, the "CERDAS" application also only integrates the DASS-21 for early screening of adolescent mental health.

Instead, "SERAYA" mobile app integrates two standardized assessment instruments, the DASS 21 and the PSS 10, enabling a more comprehensive evaluation of mental health, encompassing not only symptoms of depression, anxiety, and stress but also the user's perceived stress level. Through the implementation of a rules-based system, "SERAYA" is able to provide personalized self-healing recommendations based on the assessment results, a feature not yet fully adopted by comparable apps. "SERAYA" also complements its services with supporting features such as daily journals and educational articles to support ongoing mental health management. While it has not yet integrated direct professional consultation services like "CERDAS", "SERAYA" has successfully positioned itself strategically as a platform that not only detects but also personally guides users in taking practical steps to manage their mental health.

B. Practical and Theoretical Implications

The development of the "SERAYA" mobile app provides both practical and theoretical contributions to the field of digital mental health. Practically, it offers a low-cost, easily accessible, and mobile-based solution to address limited access to mental health services that is particularly pressing in low- and middle-income countries [4],[6],[8]. Unlike the existing apps that generally only detect symptoms without personalized guidance, such as "Serenity" [27] and "CERDAS" [28], "SERAYA" mobile app combines the DASS-21 and PSS-10 instruments to deliver a tailored self-healing intervention. This directly addresses the research gap identified in the introduction, where personalization was emphasized as a key factor for mental health support [29]. Importantly, consistent with previous evidence that mobile interventions are cost-effective and accessible [16], "SERAYA" mobile app offers a free and scalable solution that can be widely adopted to strengthen early detection and prevention in Indonesia. Qualitative usability analysis revealed that young adult users were able to navigate and understand the app effectively, completing tasks quickly. This suggests that the app could serve as a first-line support tool for a digitally literate population. Meanwhile, older users experienced difficulties with features such as One-Time Password (OTP) verification, navigation, and memory functions. These findings emphasize the importance of designing digital health solutions that accommodate diverse cognitive and technological abilities across age groups. Consequently, the app interface may require further refinement with clear guidance, intuitive navigation, and visual cues such as contrasting colors and easily recognizable icons to enhance inclusivity. Theoretically, this study demonstrates the successful integration of a rule-based expert system using forward chaining into a mental health mobile application. The combination of the DASS-21 and PSS-10 allows for a

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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more comprehensive assessment of psychological well-being, facilitating tailored recommendations [29].

C. Study Limitations

This study has several important limitations that should be considered. The extremely small sample size (n=11) and the significant demographic bias in the respondent composition considerably weaken the generalizability and reliability of the findings. Most participants were young adults (aged 21–30) with higher education backgrounds and from urban areas, which limits the applicability of the results to Indonesia's more diverse population, particularly the elderly, rural communities, or individuals with low levels of technological literacy. Validation of rules in rule-based expert systems has also not been carried out by clinical psychologists. In addition, the app currently functions as a standalone solution and does not integrate real-time professional mental health services. Consequently, while "SERAYA" mobile app can provide first-line support tool, it cannot replace professional diagnosis or therapy. Further validation with larger and more diverse samples, as well as longer-term trials, is needed before the application can be implemented more widely.

D. Recommendations for Future Research

Future research is recommended to involve a larger and more diverse sample of users, encompassing a variety of ages, cultural backgrounds, digital literacy levels, socioeconomic status, and differences between urban and rural areas, to ensure the generalizability of the findings and measure the effectiveness of the "SERAYA" mobile app in reducing symptoms of depression, anxiety, and stress while validating the accuracy of the recommendations. The development of the knowledge base should involve mental health professionals to ensure the rules used by the app are more comprehensive and accurate, and to ensure that self-healing recommendations are truly relevant and effective for each user. The application of machine learning could also be considered. However, the availability and collection of large and diverse data sets remains a challenge that future research needs to address. With sufficient data, the system could dynamically adjust recommendations based on usage patterns and user feedback, thereby increasing personalization and overall effectiveness.

Furthermore, the application's features could be focused on connecting professional services in real time for cases requiring further intervention, so that personalized self-healing support can be optimally integrated, thereby increasing the overall effectiveness of the intervention. In addition, long-term validation is also recommended, such as conducting 3–6 month longitudinal studies to assess whether the app leads to measurable improvements in psychological well-being over time.

V. CONCLUSION

The "SERAYA" mobile app has been successfully developed as a proof-of-concept digital platform for early detection of stress, anxiety, and depression using the standard DASS-21 and PSS-10 instruments. The application serves as a free and easily accessible tool to support initial screening, self-monitoring, and prevention, with an interface that emphasizes that it serves only as an initial support tool and is not a substitute for professional diagnosis. "SERAYA" mobile app provides personalized self-healing recommendations based on user scores and automatically suggests consultation with a mental health professional when necessary.

Initial testing on a small pilot group (n=11) indicated that the application functioned as designed and was well-received by users (SUS score of 80.68). There is feedback from users providing valuable input for further development. However, it is important to emphasize that these findings are preliminary and derived from a limited non-clinical sample, and therefore cannot be generalized to the entire Indonesian population. Further development should focus on testing with a more diverse population, validating recommendation rules with mental health professionals, exploring integration with existing healthcare services, and implementing machine learning for dynamic personalization. Ethical considerations, such as data privacy, cultural appropriateness of recommendations, user anonymity, and clear communication about the app's role as a support tool, must be critically considered to ensure social benefits and responsible implementation.

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Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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AUTHOR BIOGRAPHY

Enggi Wira Praja Putri Taufani is an Informatics student at the Faculty of Science and Technology, Yogyakarta University of Technology, Indonesia. She was born on May 3, 2004, in Dompu, West Nusa Tenggara. Her academic interests include web and mobile-based software development, interface design, and user experience (UI/UX). Since becoming an Informatics student in 2022, she has been involved in various course projects focused on developing digital platforms, both in the form of mobile applications and websites. She is interested in the application of technology to support education, health, and efficient data management. Furthermore, she has a passion for functional and aesthetic interface design to enhance the user experience.

Umar Zaky is a lecturer in the Information Systems program at Yogyakarta University of Technology. He was born in Jakarta in January 1987. He earned a Bachelor of Computer Science (S.Kom) degree from Yogyakarta University of Technology, Indonesia, in 2010. He graduated with a Master of Computer Science (M.Cs) degree from Gadjah Mada University, Indonesia in 2016. He has been working as a lecturer at the Faculty of Science and Technology since 2018. Currently, he is pursuing a Doctor of Computer Science degree at Dian Nuswantoro University, Indonesia. His research interests include Decision Support Systems, image and signal preprocessing, and deep learning. His current research focuses on ECG biomedical signal preprocessing models.

Corresponding author: Umar Zaky, umarzaky@uty.ac.id, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Siliwangi (Ringroad Utara), Jombor, Sleman, Yogyakarta 55285, Indonesia.
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