

SYSTEMATIC REVIEW OF EXPERT SYSTEM FOR DETECTING MENTAL HEALTH DISORDERS IN COLLEGE STUDENTS

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Abstract

There is an urgent need to detect and manage mental health disorders among college students, who often face psychological challenges due to academic pressures and significant life changes. In this context, expert systems emerge as a potential tool to assist in the diagnosis and management of mental health problems. The purpose of this study is to present the results of a systematic review of expert systems for detecting mental health disorders in college students through the systematic literature review (SLR) method. By asking four research questions covering types of mental health disorders, methods used, comparisons between methods, and testing techniques, this study limits its review to studies published in the last five years, from 2019 to 2024. This review covers various types of mental health disorders, such as depression, anxiety, stress disorders and other mental health disorders that are often experienced by the college student population. As well as evaluating and comparing methods such as forward chaining, backward chaining, certainty factor and fuzzy logic methods to identify the advantages and disadvantages of each method. Certainty Factor emerged as the most accurate method with an accuracy of 96.09% and the recommendation for combining methods for this study is certainty factor and forward chaining with an accuracy result of 100%. In addition, this study also discusses the testing process to ensure the effectiveness and accuracy of the resulting diagnosis. The findings of this systematic review are expected to provide valuable insights for the development of more effective expert systems in supporting college students' mental health.

Keywords: *expert systems, mental health disorders, SLR.*

1. INTRODUCTION

Mental health disorders are an increasingly pressing global health issue, with significant impacts on individuals, families, and communities. According to the World Health Organization (WHO), one in four people worldwide will experience a mental health disorder in their lifetime [1]. The increasing prevalence of mental health disorders, such as depression, anxiety, and bipolar disorder, has led to greater attention being paid to the importance of early detection and appropriate intervention [2].

College students often face a variety of challenges, including heavy academic workloads [3], social adjustment, and financial problems, which can contribute to mental health disorders such as depression, anxiety, and stress [4]. Students must get used to the inclusive online teaching environment and complete various learning responsibilities set by the institution. Negative emotional states, sadness, and fear, will develop in students who endure uncomfortable emotions for a long time in such an environment [5]. Data from various studies show that rates of depression and anxiety among college students have increased significantly in recent years [4],[6]. This phenomenon is a global concern, with world health organizations such as the WHO warning

that poor mental health can impact productivity and quality of life [7].

Despite the increasing attention to mental health, many college students are unaware that they have a mental health problem or feel stigma that prevents them from seeking help. The field of student management often utilizes oral presentations from class informants, surveys, and interviews to gain a deeper understanding of students' emotional states [8]. However, some students may be reluctant to share honest information directly, due to fear of negative consequences or other reasons, which can result in inaccurate data [9]. In addition, direct observation of students is also ineffective because they tend to hide their feelings. If left untreated, this problem has the potential to reduce quality of life and increase the risk of suicide. Suicide risk is expected to become a more serious concern after the COVID-19 pandemic, with significant long-term impacts [10][11]. Therefore, it is important to identify and understand the factors that affect students' mental health and effective detection or diagnosis methods.

Based on the existing problems, the proposed solution is to utilize technology through an expert system. An expert system is a system that supports decision-making by integrating knowledge from experts to solve problems in decision-making [12].

One area that can be handled by an expert system in this context is psychology [13]. With the support of experts, an expert system can collect and apply the knowledge provided to help individuals and institutions diagnose or classify mental disorders [13][14]. It is hoped that this expert system can reduce human error, speed up the diagnosis process, facilitate the work of health workers, and provide clear guidelines for related parties in handling mental disorders [15][16][17].

Systematic literature review is an important tool in collecting and analyzing previous research to provide a comprehensive picture of this issue [18][19]. By reviewing various existing studies, we can identify trends in methods, and relevant results in the diagnosis of mental health disorders among students.

This study aims to present a comprehensive systematic literature review of expert systems for mental health disorders among students. The main focus of this study is to examine the expert system methods that have been used, the symptoms and factors that influence them, the results obtained, and the challenges faced in the process of detecting or diagnosing mental health disorders among students. Thus, it is hoped that the results of this study can provide better insight for educators, researchers, and policy makers in efforts to improve students' mental health..

2. RESEARCH METHODS

The literature review method used in this study to identify, assess, and interpret all findings on a research topic, to answer previously established research questions is the Systematic Literature Review (SLR). The process includes various stages, starting from Planning, Conducting, and Reporting [20][21][22]. An explanation of the SLR stages can be seen in Figure 1 below.

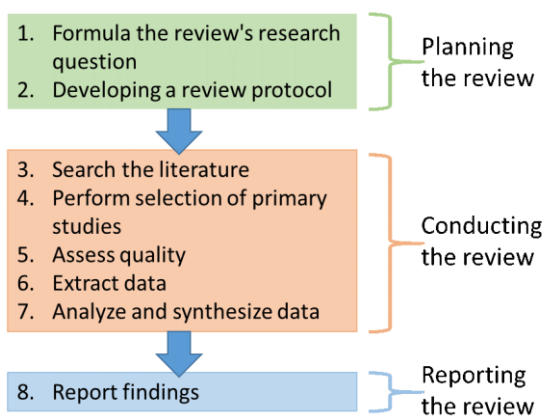


Figure 1. SLR stages

2.1. Planning

The first step taken is to determine the topic to be researched. The topic raised is an expert system for mental health disorders among students. The

selection of this topic is used by researchers to determine research objectives and determine the Research Question (RQ) which will be a guideline in research and the collection of relevant journal references. The research questions (RQ) of the review on this topic are presented in Table 1 below.

Table 1. Table Research Question (RQ)

ID	Research Question	Explanation
RQ1	Implementation of expert systems for mental disorders among students?	Analyzing the implementation of an expert system for mental disorders among students
RQ2	What methods are used for expert systems for student mental disorders?	Analyze what methods are used to create an expert system for mental disorders in students
RQ3	How do the methods used in the expert system for mental disorders in students compare?	Analyzing the comparative methods used to create an expert system for mental disorders in students
RQ4	How to test the results of the expert system research on mental health disorders in students?	Analyzing the results of testing the expert system research on mental health disorders in students

After determining the RQ, the next stage is to build an SLR (review) protocol. The review protocol describes all elements of the review, including: research objectives, research questions, search strategies, inclusion criteria, quality assessment, strategies for data extraction, synthesis, and reporting [23]. The research objectives and research questions have been described at the beginning. The search strategies in this study include: search engines or databases using Google Scholar; the keywords used are "expert system for mental health disorders in college students", with a publication year range of 2019-2024, applications for processing data using Microsoft Excel and Mendeley. The inclusion and exclusion criteria used by researchers are presented in table 2.

2.2. Conduction

The conducting stage is a stage that contains the implementation of the SLR, which should be in accordance with the review protocol that was determined at the beginning (planning stage). Starting with a literature search with a predetermined strategy. The following is the search strategy carried out by researchers presented in Figure 2.

The next stage is to select primary studies, whether this article is feasible or not for further data extraction and analysis. There are two ways to do this (as shown in Figure 2): starting with a rough screening of articles for inclusion based on a review of the appropriate titles and abstracts; the next way, followed by an assessment of the quality of the studies based on a full-text review and based on predetermined inclusion and exclusion criteria, as presented in Table 2.

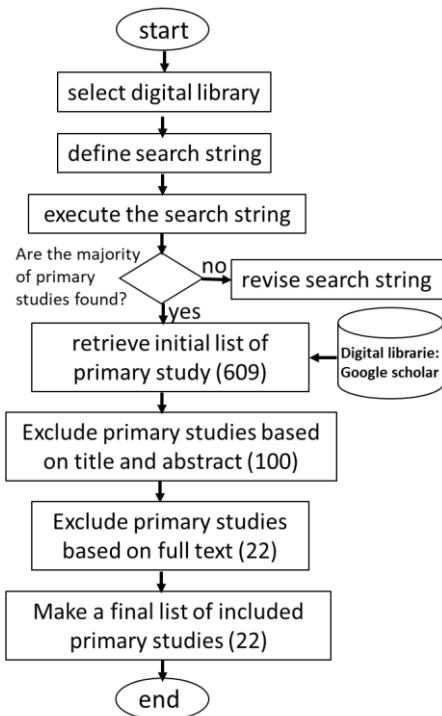


Figure 2. Search strategy in this study

Table 2. Inclusion and exclusion criteria

No	Inclusion criteria	Exclusion criteria
1	Published between 2019 - 2024	Outside the specified publishing time
2	Study in Indonesian and English	Study outside the specified language
3	According to the specified database	Outside the specified database
4	Study is a Journal and Proceedings	The study is not a journal and Proceedings
5	The case study discussed is a case study of predicting mental health disorders in students in Indonesia	outside the specified case study
6	The context discussed relates to the research question	Outside the context discussed regarding the research question

The assess quality stage is a process to filter articles or full-text journals by assessing the quality of the article. Is there any suitability, alignment and accuracy in the title, design, sample, objectives, results and also discussion of the research question. After the suitability was carried out, 22 selected articles were in accordance with the assess quality.

The next stage is the extraction of final paper data. The total final paper obtained (22) articles will go through a data extraction process where the data needed to answer the research question will be described using a data extraction template using Microsoft Excel.

The last stage in conducting is data analysis and synthesis, which aims to inform readers about what is conveyed in a literature. Further analysis and synthesis are presented with the help of tables and images.

2.3. Reporting

The reporting stage in SLR is to compile a clear and structured report on research findings. At this stage, the researcher compiles his report in the form of a scientific paper journal with the topic "expert system of mental health disorders among students". Where the contents include; title, abstract, introduction, research methods, results and discussion, conclusions and suggestions, list of references.

3. RESULTS

This section presents the results and discussion of the research from the four research questions (RQ) that were designed in the previous section, which include the types of mental health disorders, methods used, comparisons between methods, and testing techniques in the expert system for student health disorders from 2019 to 2024.

3.1. What implementations of expert systems for mental disorders exist among college students?

Mental health disorders are conditions that affect the emotions and behavior of individuals who experience them. Symptoms or signs vary according to the type of disorder experienced. To determine the type of mental disorder experienced by the sufferer, a psychiatric medical evaluation needs to be carried out through an interview between an expert, doctor or psychiatrist with the sufferer or their family. However, time and space constraints are often a challenge in practice. This is where expert systems play a role in overcoming this problem. Through an expert system, sufferers do not need to meet directly with a psychiatrist to be examined, and the diagnosis process can take place much faster. In addition, expert systems have a high level of precision and accuracy compared to human ability in dealing with mental health problems [13].

Several types of mental health disorders among students based on the results of literature that has been collected from 2019-2024, there are 22 types of mental health disorders. The following are studies that discuss expert systems for mental health disorders among students based on the type of mental health disorder, as presented in table 3.

Table 3. Expert System Research Table on Mental Health Disorders Among College Students

No	Types of Mental Health Disorders	Literatur
1	Delirium	[24]
2	Demensia	[24]
3	Amnestik	[24]
4		[24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35]
	Anxiety disorders	[32], [33], [34], [35]
5	Somatoform	[24]
6	Personality Disorders	[24]

7	Neurosif Depresif	[24]
8	Disosiatif	[24]
9		[24], [36], [37],[30],
	Skizofrenia	[31]
10	Afektif	[24]
11		[25], [36], [37], [26], [15], [16], [27], [28], [29],
	Depression	[38],[30], [31], [32], [39],[40], [34], [41]
12	Nomophobia	[42]
13	Stress	[25], [26], [28], [32]
14	Post Traumatic Stress Disorder (TPSD)	[36], [37], [27], [29]
15		[36],[37],[30]
	Bipolar]
16	Paranoid	[36]
17	Insomnia, Hipersomnia	[37], [27]
18	Distress	[43]
19	Psikotik	[29]
20	Phobia	[31], [34]
21	Obsessive Complusive Disorder (OCD)	[31]
22	Antisosial	[31], [34]

The application of expert systems for mental health disorders among students over the past five years, the most is for the type of 'Depression' disorder (there are 17 studies in the journal). Research by Teddy et al. [16] applied an expert system for early detection of depression levels in students using the Support Vector Machine (SVM) method. The expert system created on a web basis, not only handles the detection of depression in final year students (final semester), but also all students. The test results obtained an average accuracy of 90.6% [16]. Research by Muhammad [38] used the fuzzy sugeno method to calculate the level of depression in students, a case study of Computer Science students at the State University of Medan. Research by Wahyu [40] used the Naïve Bayes algorithm to design an application for early diagnosis of depression levels in students and provide information on its treatment, where the process calculates all the probabilities of each parameter. The next study by Muhammad Fikrotul Ulya As Siddieq [15] designed an expert system to assess the level of depression in students using the Certainty Factor and Forward Chaining methods. By integrating these two approaches, the system is able to produce a more precise and efficient diagnosis based on the identified symptoms. The findings of this study indicate that the expert system that has been designed can provide a diagnosis with a high level of certainty, facilitate the process of identifying depression, and offer relevant treatment recommendations [15].

The application of an expert system for mental health disorders among students over the past five years, the next most of which is 'anxiety disorders' (there are 12 studies in the journal). Research by

Septiani et al [24] developed the "SIMAHIR" website to identify mental health problems in final year students of the National Development University "Veteran" East Java using the Forward Chaining and Backward Chaining methods. In addition to diagnosing the mental health disorder 'Anxiety Disorder', this system also diagnoses other types of health disorders including: Delirium, Dementia, Amnestic, Somatoform, Personality Disorders, Neurosif Depressive, Dissociative, Schizophrenia and Affective [24]. The next study by Suliati et al [25] created an expert system to detect mental illness early using the forward chaining and certainty factor methods based on the web. The results of the blackbox test of all features on the admin and user pages run correctly and are well designed [25].

Some mental health disorders among students that have little application to expert systems include Paranoid [36], Distress [43], Psychotic [29], Obsessive Complusive Disorder (OCD) [31] and Nomophobia [42]. Research by Wilda et al [43] applied an expert system to determine the level of distress experienced by students during Covid 19 using certainty factors. Subsequent research by Bagus et al [42] created NomophobiCare, a web-based expert system that uses the Certainty Factor method, to deal with the negative effects of smartphone use.

3.2. What methods are used for the expert system for college student mental disorders?

Based on the literature collected from 2019-2024, there are several expert system methods that can be implemented in students' mental health disorders. Figure 3 below shows the expert system methods for mental health disorders presented in the form of a bar chart.

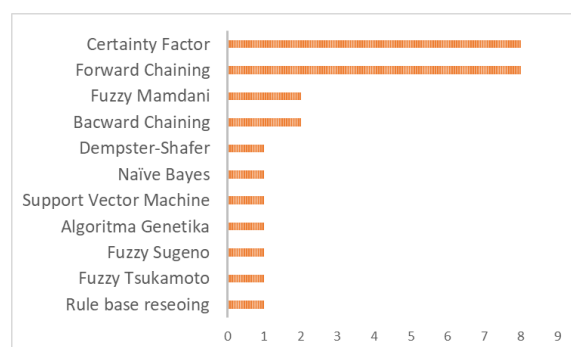


Figure 3. Expert system methods for mental health disorders in college students

The certainty factor method is one of the most frequently used expert system methods for cases of mental disorders because this method can provide a level of confidence in the final results produced by the system. The confidence factor is very suitable for application to problems that have various possible outputs. By using this method, each output will get a confidence value, which will help users make decisions. Several studies that use the certainty factor method include [25][36][26][43][15][27][42][41].

Research by Pandu [27] applies this method to develop an Android-based mental health disorder diagnosis expert system application using the Flutter framework using the Dart programming language, because this method can be a solution to solving problems with several symptoms that according to experts have weight for the diagnosed disease. Research by Isti [26] developed an expert system that diagnoses the level of mental health disorders of Amikom University Purwokerto students using the certainty factor method, because this method is suitable for finding facts or results in the diagnosis process in order to find the truth value. The test results with UAT (User Acceptance Test), obtained an average of 91.55% which means good.

The next method that is often used for expert systems for mental health disorders in students is the Forward Chaining method, because it is easy, simple, and indeed suitable for diagnosis and various other things [13]. The way this method works is to analyze/reason the various symptoms found and then conclude a diagnosis based on the available information [25][37][15][28][30][39][34][41]. Arunseto's research [30] applied the forward chaining method to build a mobile application for detecting mental health disorders in students. The output of the application is the percentage for each existing mental health disorder, which is the initial diagnosis. The next study by Arif [37] applied forward chaining to develop an expert system and adolescent mental health counseling service based on a website platform with PHP programming (native PHP). The results of testing with blackbox for the system developed showed a success rate of 100%.

The backward chaining method, in Indah's research [35], is to design an expert system to overcome anxiety disorders in students in facing final assignments. In contrast to the forward chaining method in terms of how it works, the backward method starts from the goal or hypothesis that you want to prove, then looks for rules that support it. The system checks the premise of the rule; if the premise is not met, the system will seek additional information through questions. This process is repeated until all the necessary premises are met or no further information can be obtained. If all premises are met, the goal is considered true; otherwise, the hypothesis cannot be proven.

The fuzzy logic method, in Rully's research [32] was applied to support the mental health assessment system of UNPAM Serang students. This method is suitable for solving problems related to the causes of mental health because the approach used to handle the problem of uncertainty and ambiguity in decision making [38][31][32][33]. Fuzzy itself has several branches including Tsukamoto [33], Mamdani [31] and Sugeno [38]. Research conducted by Timotius [31], the Mamdani fuzzy approach is used to categorize mental health disorders in students who are working on their thesis. The use of fuzzy is based on

discussions with psychology experts. The input variables are ten initial symptoms, each with parameters Mild, Moderate, and Severe; the output variables are six mental health disorders. Research conducted by Muhammad [38], fuzzy sugeno technique is used to measure the level of depression of students. In addition, a system is created that makes it easy for users to measure their level of depression. Computer Science students of Medan State University are the subjects of this study. The accuracy results with Mean Absolute Error (MAE) are 5.36, indicating that the average error is almost the same as the actual value. Sumarwan's study [33] created a prototype of an expert system that shows the level of anxiety of students in compiling a thesis using the MFEP method and Fuzzy Tsukamoto Inference. The test results show that the results of the expert and the system prototype (MFEP and fuzzy Tsukamoto) are each (81%) appropriate, and (19%) are not appropriate.

3.3. How do the methods used in the expert system for college student mental disorders compare?

Various methods have been developed to support expert systems in mental health disorders among students, including forward chaining, backward chaining, certainty factor, and fuzzy logic. Each has advantages and disadvantages that distinguish it in its application, which has been summarized in the following table 4.

Table 4. Comparison of methods used in expert systems for mental disorders in college students

Method	Advantages	Disadvantages	Highest Accuracy
Certainty Factor (CF)	- Capable of handling uncertainty in diagnosis.	- Less flexible for complex cases.	96.09% [27] depending on the case.
Forward Chaining	- Easy to understand and implement.	- Requires confidence values that are difficult to determine accurately.	93% [39] depending on the rules.
	- Suitable for systems with many rules and logical steps.	- Inefficient for achieving specific goals if the rule base is very large.	
	- Easy to develop and apply.	- Not effective for diagnoses requiring a "goal-driven" approach.	
Backward Chaining	- Focuses on specific goals, making it more efficient for certain problems.	- Less effective if rules are too numerous or highly branched.	91.67% [44] depending on the rules.
	- Suitable for diagnostic systems with	- Not suitable for data-driven exploration.	

Fuzzy Logic	<ul style="list-style-type: none"> specific objectives. - Capable of handling uncertainty and ambiguity in data. - Suitable for diagnosing diseases with uncertain symptoms. 	<ul style="list-style-type: none"> - Requires in-depth domain knowledge to design membership functions. - Computation can become complex with many variables. 	81% [33] depending on the model.
Rule-Based Reasoning	<ul style="list-style-type: none"> - Simple and transparent, easy for users to understand. - Suitable for simple diagnoses with fixed rules. 	<ul style="list-style-type: none"> - Rule base becomes difficult to manage if it grows too large. - Not flexible for handling complex or dynamic cases. 	90.7% [28] depending on the rules.
Genetic Algorithm	<ul style="list-style-type: none"> - Able to find optimal solutions for complex problems. - Flexible for various types of data and problems. 	<ul style="list-style-type: none"> - Requires many iterations and high computational time. - Difficult to implement for diagnoses with simple rule bases. 	85% [36] for specific cases.
Support Vector Machine (SVM)	<ul style="list-style-type: none"> - Highly effective for high-dimensional classification. - Delivers accurate results for pattern-based diagnosis. 	<ul style="list-style-type: none"> - Requires well-labeled data. - Not suitable for data with high uncertainty. 	90.6% [16] with a good dataset.
Naive Bayes	<ul style="list-style-type: none"> - Fast and easy to implement, suitable for large datasets. - Provides probabilistic results that aid diagnosis. 	<ul style="list-style-type: none"> - Independence assumption among features is often unrealistic. - Accuracy decreases if data does not meet method assumptions. 	85% [40] on specific data.

The forward chaining method is very effective in situations where initial information is available and can be further explored [25][37][15][28][30][39][34][41]. In the context of mental health disorders, forward chaining can help in diagnosing conditions accurately based on identified symptoms, such as anxiety or depression [30]. However, the disadvantage is that when many symptoms are not present or missed, the system may not reach an accurate conclusion.

Backward Chaining is more focused and efficient in some cases, because it shortens the diagnostic process by directly searching for evidence needed to verify the diagnosis, without having to process all available information [35]. In practice, backward chaining can be very useful for verifying a previously suspected diagnosis, but can be less effective if the necessary initial information is not

available. In addition, backward chaining is less able to handle uncertainty and ambiguity in symptoms that often appear in mental health disorders, because it focuses more on the verification process than interpretation.

The certainty factor method offers a flexible and adaptive approach to dealing with uncertainty in the diagnosis of mental health disorders, by assigning a probability value to each symptom or relevant information [25][36][26][43][15][27][42][41]. By assigning a confidence value, this method helps expert system users to make more informed decisions, given the level of uncertainty in the data being processed. However, its use requires special expertise and attention to avoid errors in judgment. The application of the CF method can be complex, especially in terms of determining the right confidence value for each symptom, which requires a deep understanding and experience from mental health experts. Determining the certainty factor value can be subjective, which has the potential to cause errors if not done carefully, and inaccurate judgments can lead to incorrect diagnoses. CF requires sufficient and representative data, if the data used is inadequate or of low quality, the diagnosis results can be negatively affected.

Fuzzy methods are designed to handle uncertainty and ambiguity well, which is especially important in the field of mental health, where symptoms often cannot be categorized precisely. Fuzzy logic allows for the representation of degrees of symptom severity. For example, a person may have varying levels of anxiety, and this method can measure and classify this condition more accurately. In addition, it can be adapted to different situations and types of disorders, so it can be used in different clinical contexts and with different data. Similar to the certainty factor, in order to function optimally, fuzzy methods require sufficient and representative data. If the data used is inadequate, the diagnosis results can be negatively affected. Although fuzzy logic is able to handle uncertainty, the process of drawing conclusions can be slower than other more direct methods, such as forward chaining.

3.4. How to test the results of the expert system research on student mental health disorders?

Various testing techniques have been applied by researchers to ensure the effectiveness and reliability of the systems built, including expert systems. This section presents several testing approaches to evaluate expert systems in the context of mental health disorders among college students used by researchers in recent studies in recent years (2019-2024), as presented in Table 5.

Table 5. Table of Expert System Testing Techniques for Mental Health Disorders Among Students

No.	Testing	Literatur
1	Accuracy	[24],[25],[36],[16],[29],[32],[39],[40]
2	Questionnaire	[31],[33],[42],[35]
3	Blackbox testing	[25],[37],[43],[28]
4	Mean Absolute Error (MAE)	[38]
5	Percentage of belief/trust	[26],[15],[27]

Accuracy testing is one of the most commonly used methods. Researchers evaluate how accurate the system is in producing a diagnosis that matches the diagnosis given by a mental health expert/doctor/psychiatrist. The results of this test are very important, because high accuracy indicates that the system can be relied on to provide diagnostic recommendations to users. In many studies, this test involves comparing the diagnosis results of an expert system (an expert system designed/built) with a diagnosis determined by a professional (mental health expert/doctor/psychiatrist), or it can also be compared with other expert systems (which have the same purpose).

In addition to accuracy testing, researchers also use questionnaires to collect feedback from users and experts about the performance of the system. Through this questionnaire form, they can assess aspects such as clarity, usability, ease and user satisfaction. The results of this questionnaire provide valuable insights into how the system is received by users. Technically, filling out this questionnaire is done directly, namely filling out a form on paper, and online, using an online platform (such as Google Form) or via a website. Some researchers use User Acceptance Test (UAT) [28],[42] to get feedback from users. With online questionnaires, it is possible to collect faster, wider and more diverse data from various users and mental health experts.

Black box testing is an approach used to test software that has been developed, including testing on small units and integrated end results to evaluate the functionality of the software, in this case an expert system. In this approach, researchers focus on the input and output of the system without paying attention to the internal processes that occur such as design or program code [45]. The goal is to assess the functionality of the system in real conditions by providing a number of symptoms (mental health disorders) as input and observing the output produced, whether it is in accordance with the desired specifications. If the results obtained during testing do not match what is expected, then the system is considered to have an error [45]. In addition, this method is very suitable for beginners because it does not require mastery of a particular programming language [46].

Testing with a percentage of confidence or trust, often known as the "certainty factor" in the context of expert systems, is a method used to measure the level of confidence or trust in the results of a diagnosis or

decision taken by the system. This method is important, especially in areas involving uncertainty, such as the diagnosis of mental disorders. Test results can be interpreted by considering the CF value. For example, results with a CF close to +1 indicate a diagnosis that is highly likely to be correct, while a CF close to 0 or negative indicates high uncertainty [47]. Testing using Mean Absolute Error (MAE) is one of the statistical methods that can be applied to assess the performance of expert systems, especially in the context of mental health disorder detection [38]. MAE measures the average absolute error between the predicted value generated by the system and the known actual value [48]. The lower the MAE value, the more accurate the prediction generated by the system. Conversely, a high MAE value indicates a significant error in the diagnosis [38].

4. DISCUSSION

The appropriateness of the use of methods in a study is highly dependent on the objectives to be achieved as well as the availability and quality of the data available. Each method has its own advantages and disadvantages, so choosing the right method requires careful consideration of the research context. For example, for systems with high uncertainty, Fuzzy Logic and Certainty Factor are suitable for use so that the accuracy is relative to how the uncertainty is modeled, this is evidenced by the highest accuracy for this study of 96.09% [27] in the Certainty Factor method. If to handle large and high-quality data, then SVM, naïve bayes and Genetic Algorithms are very suitable for use, and have high accuracy on highly structured data. If for a system with many rules, then the forward chaining method is suitable for use and is very easy to develop and implement.

In several studies as described in references [15][25][33], two methods were applied in one research case. This shows that sometimes one method alone is not enough to provide a comprehensive picture, so a combination of methods can be used to complement each other and produce more valid or reliable results. The recommendation for combining the two methods in this study's expert system is Certainty Factor and forward chaining, this is proven by expert testing by comparing the results of self-conditions in the system with the results of self-conditions from experts with 6 diseases showing 100% accuracy [25].

Research can also measure the effectiveness of various methods by comparing the application of one method with another in the same case. This comparative approach not only helps in choosing the best method, but also provides deeper insight into the extent to which a particular method can provide more accurate, relevant, or efficient results in a specific research context. In many cases, the findings of this comparison can open up opportunities for the development of new methods or adaptation of

methods that are more appropriate to field conditions or existing data.

5. CONCLUSION

The conclusion of this study shows that expert systems have significant potential in detecting mental health disorders in college students, covering various types of conditions such as depression, anxiety, bipolar, stress disorders, schizophrenia, and other mental health disorders. By relying on expert knowledge, expert systems provide more accurate and consistent decisions, and can be accessed at any time, increasing efficiency in the diagnosis process. In addition, expert systems are able to process large data quickly, reduce the risk of human error, and manage uncertainty, thereby helping users in complex situations.

Through this systematic literature review (SLR), various methods used in expert systems, including rule-based algorithms, machine learning, and certainty factor methods, have been evaluated and compared. Each method has its own advantages and disadvantages. The method will be effective in solving problems in expert systems if it is applied according to the situation at hand. Innovation in the application of methods in expert systems can include improvisation or combining two or more methods to achieve a solution.

The test results from data processing are the main core of the expert system. In this process, there are several steps to test the diagnosis results produced by the system. One of the most appropriate methods is to compare the results of the system's diagnosis with the diagnosis by an expert, this can be done by testing the accuracy. In addition, there are various testing techniques that are no less important, such as user testing, which are also discussed to ensure that the developed system can provide accurate and useful diagnoses. By adopting various testing methods, researchers and developers can ensure that the resulting system is not only accurate in diagnosis, but also user-friendly, safe, and can operate well in various conditions. The combination of these techniques will provide a more complete picture of the reliability and effectiveness of the expert system.

Overall, the results of this systematic review provide valuable insights for the development of more effective and relevant expert systems in supporting student mental health. This research is expected to be an important reference for developers and researchers who want to create innovative solutions to address mental health challenges in the student population.

In future research, it is recommended to develop an expert system model that integrates various methods, such as rule-based algorithms (for example forward chaining) and machine learning (for example SVM), to improve the accuracy of the diagnosis of mental health disorders in students. The challenge faced by all expert system methods studied is the

weakness in terms of data. In order to function optimally, sufficient and representative data is needed, if the data used is inadequate or of low quality, the diagnosis results can have a negative impact.

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