# Expert System to Detect Early Depression in Adolescents using DASS 42

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# Expert System to Detect Early Depression in Adolescents using DASS 42

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Abstract: Around 5% adolescents in Indonesia suffer from depression at the certain time. To identify the level of depression, direct consultation with an expert like alienist or psychologist is needed. However, the problem is the number of experts in hospital and culture social environment is limited, also the society is not used to do consultation to alienist or psychologist. Therefore, a system that can help the medical to detect early depression disorder is needed, before the adolescents do the next consultation to the medical. The system called as expert system with web based which built by Case Based Reasoning (CBR) and using Simple Matching Coefficient (SMC) method also DASS 42 as the research instrument. Based on the 200 data testing on 500 and 700 case base, this expert system can detect the early disorder with an precision rate more than 90%. So that, with this expert system the early disorder can be done accurately and fast.

## 1 INTRODUCTION

Depression is a mood disorder characterized by loss of feelings of control and subjective experience of severe suffering. Depression will cause feelings of depression (sadness, disappointment, futility), loss of energy and interest, feelings of guilt, loss or difficulty concentrating, loss of appetite to suicidal desires and sometimes self-degrading behaviour (Faia et al., 2017; Shen et al., 2017). Depression that is not detected early in adolescents can eventually lead to serious difficulties in school, work, and personal adjustment which often continues in adulthood. To be able to correctly identify the level of depression experienced by a adolescents, parents or teachers must consult directly with experts, both psychiatrists and psychologists. However, the obstacle is the limited number of psychiatric experts who are not available in all hospitals and the sociocultural environment in the community that is not accustomed to consulting a psychiatrist and psychologist (Haryanto et al., 2016; Syafitri and Apdian, 2016; Syafitri and Saputra, 2017).

Expert system is a computer program designed to solve problems like an expert, by transferring expertise so that other people (non-experts) can solve problems that are usually carried out by an expert (Gu et al., 2017; Rahman et al., 2018). The representation of knowledge representation using Case Based Reasoning (CBR) is a collection case-based that has never happened before. CBR uses solutions from previous cases that are similar to new cases to solve problems. Various methods can be used to measure the level of similarity of old cases with new cases. One of similarity methods used is Simple Matching Coefficient (SMC).

Some studies in the domain of expert systems with CBR used as a reference are research conducted by Faizal, E (2014) applying CBR to build a system that has the ability to diagnose cardiovascular disease based on similarity in previous cases using method SMC. The test results show that the system built has a sensitivity value of 97.06%, specificity of 64.29%, positive predictive value (PPV) of 86.84%, negative predictive value (NPV) of 90.00%, accuracy of 87.50% with level error (error rate) of 12.50% (Faizal, 2014; Syafitri and Sari, 2017; Syafitri et al., 2018).

## 2 RESEARCH METHOD

Research method is the stages passed by the researcher to get description of the research. The stages passed in the research method are follows:

### 2.1 Data Collection

The data collection techniques needed in making this system are as follows:



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- Interviews conducted directly with Psychology experts.
- Distribution of online questionnaires to 700 adolescents aged 17 to 21 through Google Forms to obtain case base data and test data.
- Literature studies through scientific references from various sources related to the problem under study, both from books, scientific journals and from other readings that can be justified.

## 2.2 Adolescents

In English adolescents are called adolescent, derived from the word adolescent which means growing toward maturity. Adolescents is a period of transition between childhood and adulthood. At this time, adolescents experience the development of achieving physical, mental, social and emotional maturity and the emotional state of adolescents is still unstable because it is closely related to hormonal conditions. Hurlock (1980), divides adolescents into two parts, namely early adolescents and late adolescents. Early adolescents lasts approximately from the age of 13-16 years and the late adolescents starts from the age of 17-21 year(Holmbeck, 2018; Weis, 2017).

Adolescents is a period of developmental transition between childhood and adulthood which includes biological, cognitive and social emotional changes. In English teenagers are called adolescent, derived from the word adolescent which means growing toward maturity. Adolescence is a period of transition between childhood and adulthood. At this time, adolescents experience the development of achieving physical, mental, social and emotional maturity and the emotional state of adolescents is still unstable because it is closely related to hormonal conditions. Emotional emotions dominate and control themselves from a realistic mind (Rosenberg, 2015; Coleman, 2006).

## 2.3 Depression

Depression is a period of disruption of human function related to natural feelings of sadness and accompanying symptoms, including changes in sleep patterns and appetite, psychomotor, concentration, anhedonia, fatigue, hopelessness and helplessness, and suicide. Depression is likened to flu, because depression can occur in all circles, including adolescents (Kaplan et al., 2010; Amelia et al., 2018). There are 3 levels of depression :

- Mild Depression
  At this level, the symptoms usually affect the daily activities of people who experience it such as being less interested in doing things that are usually done, easily angry, the motivation to work becomes less. This depression is not too disturbing, but must be treated to prevent the condition from getting worse.

- Middle Depression (Moderate Depression)
  At this level, this depression causes a person to experience difficulties in terms of social, work and domestic activities. In moderate depression, usually a person becomes less confident so he or she is less motivated to do something. Often a person starts to worry about things that are unnecessary, more sensitive, and vulnerable to feelings of hurt or offense in personal relationships.

- Severe Depression
  At this level, this depression causes a person to experience severe suffering such as feeling a loss of self-esteem or feeling useless and guilty, and wanting to commit suicide. A person who is severely depressed cannot manage his emotions so that he easily experiences feelings of despair. People with severe depression may also suffer from delusions, hallucinations or stupor depressive.

Anxiety can be divided according to the source of reason, namely: Anxiety that comes from the environment, called objective anxiety that is anxiety caused by the environment and does not need treatment, because it is one of the factors ”self-care”. Anxiety in the body is called vital anxiety, namely anxiety that originates in the body and functions as a definition mechanism that protects the individual. Awareness of consciousness is called conscience anxiety, that is, individuals have an awareness of morality that will protect individuals against acts that are immoral (Lovibond and Lovibond, 1995).

Problems experienced by adolescents in fulfilling the tasks of adolescent development, namely:

- Personal problems, namely problems related to situations and conditions in the home, school, physical condition, appearance, emotions, social adjustment, duties, and values.

- Typical teen problems, namely problems that arise due to unclear status in adolescents, such as the problem of achieving independence, misunderstanding, the existence of greater rights and fewer obligations imposed by parents.

## 2.4 Expert

Systems Knowledge-based systems, also known as expert systems, are one branch of artificial intelligence, which in the commercial world is called a system that can effectively and efficiently carry out tasks that do not really require experts. Expert systems are also known as advisory systems, knowledge systems, intelligent work assistance systems or operational systems (Aronson et al., 2005).

## 2.5 Case based Reasoning (CBR)

Case Based Reasoning (CBR) is a system that aims to resolve a new case by adapting the solutions found in the previous case that are similar to the new case. The basic idea of CBR is to imitate human abilities, namely solving new problems using answers or experiences from old problems. Representation of knowledge is made in the form of cases. Each case contains problems and answers, so the case is more like a certain pattern. The way CBR works is to compare new cases with old cases. If the new case bears a resemblance to the old case, the CBR will provide an answer to the old case for the new case. If there is no match, the CBR will adapt, by inserting the new case into a case base, so that indirectly CBR knowledge will increase (Li et al., 2018).

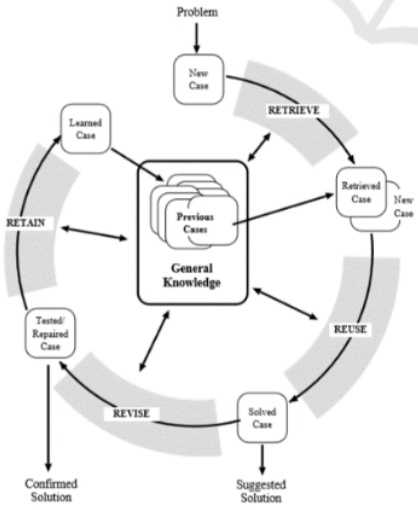


Figure 1: System Architecture CBR.

## 2.6 Simple Matching Coefficient (SMC)

There are a variety of techniques that can be used to measure the similarity of a case with an old case on a case base. One of methods similarity that can be used is Simple Matching Coefficient (SMC) with equation (1) (Faizal, 2014).

$$SMC(X,Y) = \frac{M_{11}+M_{00}}{M_{01}+M_{10}+M_{11}++M_{00}} \quad (1)$$

Description:
X = Old case
Y = New case
M11 = Number of attributes where X = 1 and Y = 1
M00 = Number of attributes where X = 0 and Y = 0
M01 = Number of attributes where X = 0 and Y = 1
M10 = Number of attributes where X = 1 and Y = 0

## 2.7 Feasibility System

Feasibility system is obtained by finding the value of precision and recall systems based on comparison of the results of detection by experts using the DASS 42 calculation with the results of detection by the system. Before getting precision and recall values, need the True Positive (TP), True negative (TN), False Positive (FP) and False Negative (FN). These values are measured using information retrieval (Huibers et al., 1996). Precision and recall can go through the formulas in equations (2) and (3).

$$Precision(P) = \left| \frac{TP}{TP+FT} \right| * 100\% \quad (2)$$

$$Recall(R) = \left| \frac{TP}{TP+FN} \right| * 100\% \quad (3)$$

## 2.8 DASS 42

The severity of depression, anxiety, and stress what a person experiences can be measured on many scales including using the Depression Anxiety Stress Scale 42 or abbreviated with DASS 42 developed by Lovibond & Lovibond (1995). DASS is a 42-item questionnaire that includes three scales to measure negative emotional states of depression, anxiety and stress. Each of the three scales contains 14 items. Scores for each respondent during each sub-scale, then evaluated according to their severity (Lovibond and Lovibond, 1995).

Table 1: Score DASS 42 (Lovibond & Lovibond 1995).

| Level of | Depression | Anxiety | Stress |
|---|---|---|---|
| Normal | 0-9 | 0-7 | 0-14 |
| Mild | 10-13 | 8-9 | 15-18 |
| Medium | 14-20 | 10-14 | 19-25 |
| Severe | 21-27 | 15 - 19 | 26 - 33 |
| Extremely severe | >28 | >20 | >34 |

## 3 RESULT AND DISCUSSION

### 3.1 Testing on 500 Case Bases

There are 100 test data with an equal number of detection rates of 20: 20: 20: 20: 20 in anxiety detection, 20: 20: 20: 20: 20 in stress detection and 20: 20: 20: 20: 20 in depression detection . The comparison sample of detection results is shown in table 2.

Based on table 2, the number of detection levels in the test data is shown in table 3.

Testing on Detection of Depression

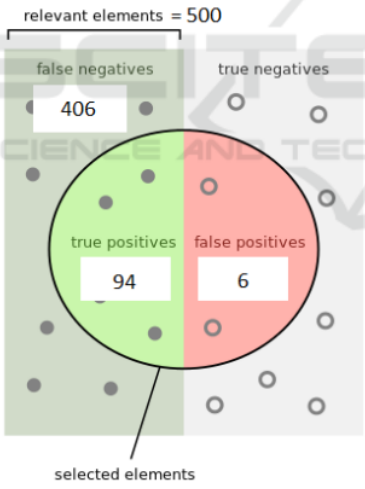


Figure 2: Information Retrieval on Comparison of Detection Results of Depression (Based on Table 3).

Based on figure 2, the precision and recall values of depression detection can be found as follows:

$$\begin{aligned} Precision(P) &= \left[\frac{TP}{TP+FT}\right] * 100\% \\ &= \left[\frac{94}{94+6}\right] * 100\% \\ &= \left[\frac{94}{100}\right] * 100\% \\ &= 94\% . \end{aligned} \tag{4}$$

$$\begin{aligned} Recall(R) &= \left[\frac{TP}{TP+FN}\right] * 100\% \\ &= \left[\frac{94}{94+406}\right] * 500\% \\ &= \left[\frac{94}{500}\right] * 100\% \\ &= 18,80\% . \end{aligned} \tag{5}$$

Testing the Amount of Random Detection Rate.

There are 100 test data with a number of random detection rates of 14: 15: 30: 25: 16 in anxiety detection, 11: 22: 41: 17: 9 in stress detection and 8: 13: 35: 35: 9 in depression detection. The comparison sample of detection results is shown in table 4.

Based on table 4, the number of detection levels obtained in the test data is shown in table 5.

Testing on Detection of Depression

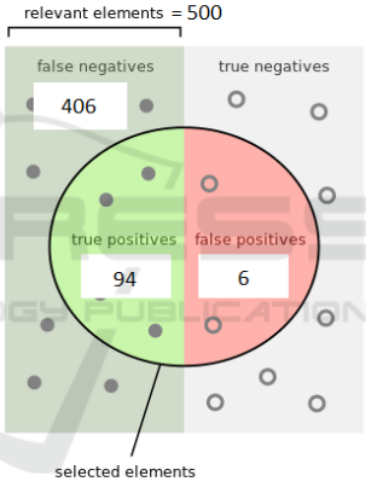


Figure 3: Retrieval of Information on Comparative Results Detection of Depression (Based on Table 5).

Based on Figure 3, the precision and recall values of depression detection can be found as follows:

$$\begin{aligned} Precision(P) &= \left[\frac{TP}{TP+FT}\right] * 100\% \\ &= \left[\frac{97}{97+3}\right] * 100\% \\ &= \left[\frac{97}{100}\right] * 100\% \\ &= 97\% . \end{aligned} \tag{6}$$

$$\begin{aligned} Recall(R) &= \left[\frac{TP}{TP+FN}\right] * 100\% \\ &= \left[\frac{97}{97+403}\right] * 100\% \\ &= \left[\frac{97}{500}\right] * 100\% \\ &= 19,40\% . \end{aligned} \tag{7}$$

Table 2: Comparison of Test Data Detection Results by Experts with a System with an Equal Alignment Detection Level.

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Expert Results | Expert Results | Expert Results | Expert Results | Expert Results | Expert Results |
| 1 | Normal | Normal | Normal | Normal | Normal | Normal |
| 2 | Normal | Normal | Normal | Normal | Normal | Normal |
| 3 | Normal | Normal | Normal | Normal | Normal | Normal |
| 4 | Normal | Normal | Normal | Normal | Normal | Normal |
| 5 | Normal | Normal | Normal | Normal | Normal | Normal |
| 6 | Normal | Normal | Normal | Normal | Normal | Normal |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 97 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 98 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 99 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 100 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |

Table 3: Number of Detection Levels on Test Data (Based on Expert Results).

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Detection rate | Total | Detection rate | Total | Detection rate | Total |
| 1 | Normal | 20 | Normal | 20 | Normal | 20 |
| 2 | Mild | 20 | Mild | 20 | Mild | 20 |
| 3 | Medum | 20 | Medum | 20 | Medum | 20 |
| 4 | Severe | 20 | Severe | 20 | Severe | 20 |
| 5 | Extremely severe | 20 | Extremely severe | 20 | Extremely severe | 20 |
| | **Total** | **100** | **Total** | **100** | **Total** | **100** |

Table 4: Comparison of Test Data Detection Results by Experts with a System with an Equal Alignment Detection Level.

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Detection rate | Total | Detection rate | Total | Detection rate | Total |
| 1 | Normal | 14 | Normal | 11 | Normal | 8 |
| 2 | Mild | 15 | Mild | 22 | Mild | 13 |
| 3 | Medum | 30 | Medum | 41 | Medum | 35 |
| 4 | Severe | 25 | Severe | 17 | Severe | 35 |
| 5 | Extremely severe | 16 | Extremely severe | 9 | Extremely severe | 9 |
| | **Total** | **100** | **Total** | **100** | **Total** | **100** |

## 3.2 Testing on 700 Case Bases

Testing is focused on similarity testing, where the data to be tested consists of 200 depression data test that are tested on 500 case base and on 700 case base. 200 data test on the detection of depression are subdivided into 2 which 100 data test with an equal number of detection levels with 20:20:20:20:20 data and 100 data test with a random number of detection levels with 8:13:35:35:9 data. Experts will look for detection results in the data test on each test using the DASS 42 calculation.

Based on table 6, obtained the number of detection levels in the test data shown in table 7.

Testing on Detection of Depression

Based on figure 2, the precision and recall values of depression detection can be found as follows:

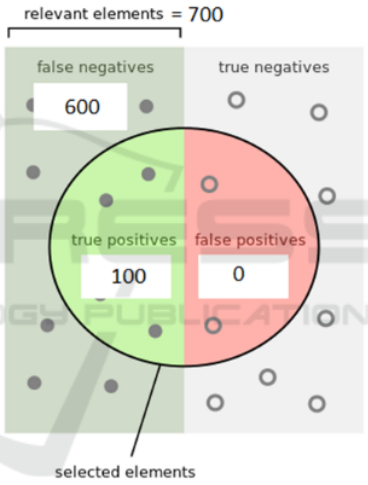


Figure 4: Information Retrieval on Comparison of Detection Results of Depression (Based on Table 3).

$$Precision(P) = \left[\frac{TP}{TP+FT}\right] * 100\% = \left[\frac{100}{100+0}\right] * 100\% = \left[\frac{100}{100}\right] * 100\% = 100\% . \quad (8)$$

$$Recall(R) = \left[\frac{TP}{TP+FN}\right] * 100\% = \left[\frac{100}{100+600}\right] * 100\% = \left[\frac{100}{700}\right] * 100\% = 14,29\% . \quad (9)$$

Testing the Amount of Random Detection Rate

Table 5: Number of Detection Levels on Test Data (Based on Expert Results).

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Expert Results | Expert Results | Expert Results | Expert Results | Expert Results | Expert Results |
| 1 | Mild | Mild | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 2 | Mild | Mild | Severe | Severe | Extremely severe | Extremely severe |
| 3 | Mild | Medium | Severe | Severe | Mild | Medium |
| 4 | Normal | Normal | Severe | Severe | Severe | Severe |
| 5 | Mild | Mild | Severe | Severe | Medium | Medium |
| 6 | Mild | Mild | Severe | Severe | Severe | Severe |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 97 | Extremely severe | Extremely severe | Mild | Mild | Medium | Medium |
| 98 | Extremely severe | Extremely severe | Medium | Medium | Medium | Medium |
| 99 | Severe | Severe | Mild | Mild | Severe | Severe |
| 100 | Severe | Medium | Medium | Medium | Medium | Medium |

Table 6: Comparison of Test Data Detection Results by Experts with Systems with Amount of Equal Level Detection.

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Detection rate | Total | Detection rate | Jumlah | Detection rate | Total |
| 1 | Normal | 20 | Normal | 20 | Normal | 20 |
| 2 | Mild | 20 | Mild | 20 | Mild | 20 |
| 3 | Medium | 20 | Medum | 20 | Medum | 20 |
| 4 | Severe | 20 | Severe | 20 | Severe | 20 |
| 5 | Extremely severe | 20 | Extremely severe | 20 | Extremely severe | 20 |
| | **Total** | **100** | **Total** | **100** | **Total** | **100** |

There are 100 test data with a number of random detection rates of 14: 15: 30: 25: 16 in anxiety detection, 11: 22: 41: 17: 9 in stress detection and 8: 13: 35: 35: 9 in depression detection. The comparison sample of detection results is shown in table 8.

Based on table 8, the number of detection levels in the test data is shown in table 9.

Testing on Detection of Depression

Based on figure 5, we can find the value of precision and recall value of depression detection as follows:

$$\begin{aligned} Precision(P) &= \left[\frac{TP}{TP+FT}\right] * 100\% \\ &= \left[\frac{100}{100+0}\right] * 100\% \\ &= \left[\frac{100}{100}\right] * 100\% \\ &= 100\% . \end{aligned} \tag{10}$$

$$\begin{aligned} Recall(R) &= \left[\frac{TP}{TP+FN}\right] * 100\% \\ &= \left[\frac{100}{100+600}\right] * 100\% \\ &= \left[\frac{100}{700}\right] * 100\% \\ &= 14,29\% . \end{aligned} \tag{11}$$

Based on Table 10, the first with 100 test data with the equal number of detection with 20:20:20:20:20 data which tested at 500 case base explained that percentage of precision is 94% and percentage of recall is 18.80%. The second test with 100 data

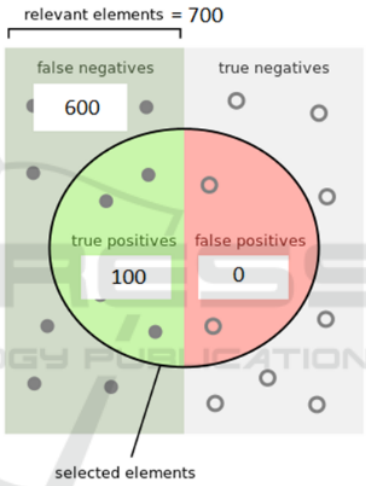


Figure 5: Information Retrieval on Comparison of Detection Results of Depression (Based on Table 9).

test with the random number of detection with 8:13:35:35:9 data which tested at 500 case base explained that percentage of precision is 97% and percentage of recall is 19.40%.

Based on table 11, both the third test with 100 with the equal number of detection with 20:20:20:20:20 data and the fourth test with 100 test data with the random number of detection with 8:13:35:35:9 data which was tested at 700 case base explained that all percentages of precision is 100

Based on the testing, the percentage of precision is 100% at 700 case base and are ¿ 90% at 500 case base so it can be concluded that the number of case base affects the percentage of precision in the system.

Table 7: Number of Detection Levels on Test Data (Based on Expert Results).

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Expert Results | Expert Results | Expert Results | Hasil Sistem | Expert Results | Expert Results |
| 1 | Normal | Normal | Normal | Normal | Normal | Normal |
| 2 | Normal | Normal | Normal | Normal | Normal | Normal |
| 3 | Normal | Normal | Normal | Normal | Normal | Normal |
| 4 | Normal | Normal | Normal | Normal | Normal | Normal |
| 5 | Normal | Normal | Normal | Normal | Normal | Normal |
| 6 | Normal | Normal | Normal | Normal | Normal | Normal |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 97 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 98 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 99 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |
| 100 | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe | Extremely severe |

Table 8: NumberComparison of Detection Results of Test Data by Experts with Systems with Amount of Random Detection Rate.

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Expert Results | Expert Results | Expert Results | Hasil Sistem | Expert Results | Expert Results |
| 1 | Mild | Mild | Extremely Severe | Extremely Severe | Extremely Severe | Extremely Severe |
| 2 | Mild | Mild | Severe | Severe | Extremely Severe | Extremely Severe |
| 3 | Mild | Mild | Severe | Severe | Mild | Mild |
| 4 | Normal | Normal | Severe | Severe | Severe | Severe |
| 5 | Mild | Mild | Severe | Severe | Medium | Medium |
| 6 | Mild | Mild | Severe | Severe | Severe | Severe |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 97 | Extremely Severe | Extremely Severe | Mild | Mild | Medium | Medium |
| 98 | Extremely Severe | Extremely Severe | Medium | Medium | Medium | Medium |
| 99 | Severe | Severe | Mild | Mild | Severe | Severe |
| 100 | Severe | Severe | Medium | Medium | Medium | Medium |

Table 9: Number of Detection Levels on Test Data (Based on Expert Results).

| No | Anxiety Detection Results | | Stress Detection Results | | Depression Detection Results | |
|---|---|---|---|---|---|---|
| | Detection rate | Total | Detection rate | Jumlah | Detection rate | Total |
| 1 | Normal | 14 | Normal | 11 | Normal | 8 |
| 2 | Mild | 15 | Mild | 22 | Mild | 13 |
| 3 | Medum | 30 | Medum | 41 | Medum | 35 |
| 4 | Severe | 25 | Severe | 17 | Severe | 35 |
| 5 | Extremely severe | 16 | Extremely severe | 9 | Extremely severe | 9 |
| | Total | 100 | Total | 100 | Total | 100 |

Table 10: Testing Conclusions on 500 Case Base.

| Detection | Tested on 500 Case Base | | | |
|---|---|---|---|---|
| | 100 Equal Data Test | | 100 Random Data Test | |
| | Precision | Recall | Precision | Recall |
| Depression | 94% | 18,80% | 97% | 19,40% |
| Average | 95,33% | 19,07% | 95,67% | 19,13% |

Table 11: Test Conclusions on 700 Case Base.

| Detection | Tested on 700 Case Base | | | |
|---|---|---|---|---|
| | 100 Equal Data Test | | 100 Random Data Test | |
| | Precision | Recall | Precision | Recall |
| Depression | 100% | 14,29% | 100% | 14,29% |
| Average | 100% | 14,29% | 100% | 14,29% |

## 4 CONCLUSIONS

Testing is focused on similarity testing, where the data to be tested consists of 200 depression data test that are tested on 500 case base and on 700 case based. 200 data test on the detection of depression are subdivided into 2 which 100 data test with an equal number of detection levels with 20:20:20:20:20 data and 100 data test with a random number of detection levels with 8:13:35:35:9 data. Experts will look for detection results in the data test on each test using the DASS 42 calculation.

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