Model and Application of Web-based e-Assessment With Combination of Rule Base Reasoning (RBR) and Case Base Reasoning (CBR) Methods

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***Abstract* --- E-Assessment or known as the Computer Based Assessment, Computer-Based Testing, or the Computerized Testing is a method in the management of the test with a response that was recorded electronically. Application of rule-based and cases in e-assessment can improve the functionality of the system assessment. Rule-based reasoning is a way of reasoning based on specific situations using the short-term memory and long-term memory as a basis to perform an action. While the case-based reasoning is based reasoning previous cases. By utilizing a computer, this reasoning process of changing the subject of human actors into the computer. Conducted by human reasoning is replaced by machine-based reasoning inference based on the rules and the facts of the case. In the assessment activity, both models this reasoning can be used to determine the format about assessment, how the implementation of assessment, similarity analysis of calculation and similarity analysis of assessment suggestions. To formulate rules can be used ID3 algorithm that will generate decision trees and tables of rules determining the format of questions and how assessment. As for similarity calculation of value analysis and advice in the assessment to determine the weight and the weight of the proximity attribute similarity assessment of cases using a similarity function of new cases with old cases using nearest neighbor algorithm. The combination of rule-based reasoning and case-based reasoning be integrated into the framework of e-assessment system based on web.**

Keywords: E-Assessment, Rule-based reasoning, Case-based reasoning, ID3, Similarities, Nearest Neighbor.

I. INTRODUCTION

Assessment or an assessment instrument to measure the success rate of learners in the learning process. An assessment is not simply to seek answers to questions about what, but rather directed at answering the question of how or how far a process or a result obtained by a person (Asmawi and Nasution, 2005). An assessment or evaluation related to a measurement. In some respects the nature of the broader evaluation because the evaluation also includes assessment of formal and intuitive judgments about the progress of learners. The evaluation also includes an assessment of what is good and what is expected. Thus the correct measurement result is a solid basis for assessing (Thorndike and Hagen, 1961). While the evaluation according to Stufflebeam and Shinkfield (1985) defined as the "Evaluation is the systematic assessment of the worth or merit of some objects" that the evaluation is a systematic assessment of the value and benefits of multiple objects. In the digital age assessment can be done using electronic media in the form of a computer then it is termed as e-assessment. E-Assessment or known as the Computer Based Assessment, Computer Based Testing, or Computerized Testing is a test method in the management of the response was recorded electronically. The stages in the implementation of e-assessment using the computer for learners and for educators. The functions in e-assessment can occupy a central role in collecting detailed information about understanding and achievement of learners and subsequently in compiling and analyzing this data (Whetton & Sainsburry, 2007).

II. THEORY FOUNDATION

A. Rule-Based Reasoning.

Rule-based reasoning using a rule to make the rules in the knowledge that will be saved. In this context the necessary knowledge base as a repository of knowledge. A knowledge base is stored data, the rules, the relationship between the data with the rules, and the conclusions of inference. So that the stored knowledge base of facts and the steps in drawing a conclusion as a rule in completion of problem. Block diagram of a rule-based reasoning as in figure 1 (Durkin, 1994).

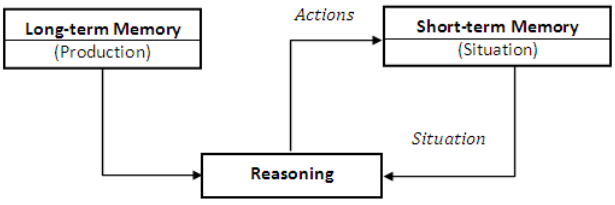

Fig. 1. Rule-Based Reasoning System

By utilizing a computer, this reasoning process to change the subject from a human actor into a computer

device. Reasoning done by humans is replaced with reasoning based inference engine. Knowledge-based system is a system of knowledge structures to analyze the information stored in memory using a set of rules that are in the knowledge base and uses an inference engine as a tracking device in order to obtain an inference rule or new information. Rule-based systems is also known as production systems that dididefinisikan as a way of solving human problems by combining a new problem situations that tesimpan short-term memory in humans with a production that is stored in human long-term memory resulting a new information that is stored in short-term memory (Durkin, 1994). Block diagram of a rule-based system as in figure 2.

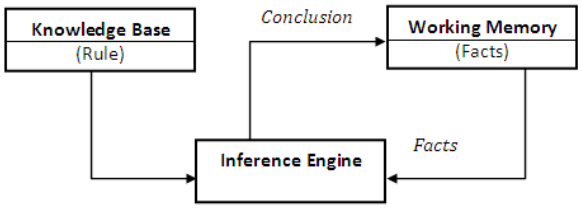

Fig. 2. Rule-Based Reasoning

B. Case Base Reasoning.

Case-based reasoning is a problem solving based on experiences and knowledge (Aamodt and Plaza, 1994). Case-based reasoning is described as a process in figure 3.

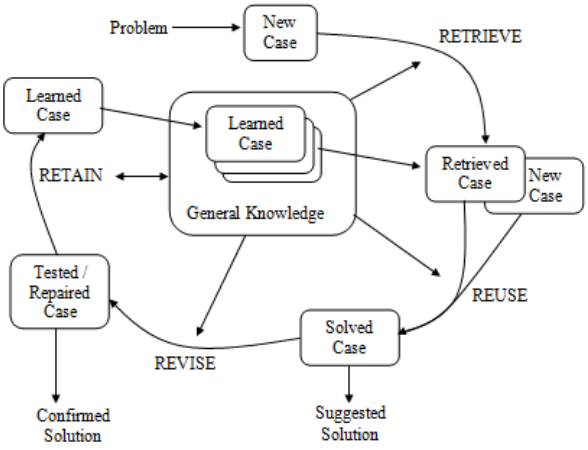

Fig. 3. Case Base Reasoning

Stages of case base reasoning is generally described as follows.

1). Retrieve
This stage is used to obtain similar cases by comparing new cases with a set of cases in the past. This stage begins with problem identification stage and ends when the case is being searched for a solution has been found to have similarities with the cases that have been there. Stage consists of two steps of identifying a problem, start the matching and selection.

2). Reuse
Reuse of existing cases and been used to solve current problems. Reuse of a case in the context of the new case focuses on two aspects, namely the differences existing case with new cases and how to regain (retrive) old cases that can be used as a solution in case the new one. The solution to answer the second question that can be used for re-use existing case can implement two methods, namely: the use of re-solution of the cases (transformational reuse) and the use of existing methods to produce a solution (derivational reuse).

3). Revise
This stage is used to change and adopt solutions that are offered if needed. There are two main tasks in this stage are:
a). Evaluation of solution, how the results obtained after comparing the solution with the actual circumstances. At this stage of the evaluation often requires a long time depending on the application being developed.
b). Fixing error, fixes a case involves the introduction of solutions made mistakes and took the explanation of the problem.

4). Retain
Keep using the latter solution as part of new cases. At this stage occurred the incorporation of new cases of solutions to correct existing knowledge. At this stage the activity of indexing, integrating, and extract the new solution. Furthermore, new solutions are stored into the knowledge base to solve problems that will come.

Case-based reasoning method is applied to find similarities cases using nearest neighbor algorithm. Nearest Neighbor is an approach to search for cases by calculating the affinity between the new case with an old case, which is based on matching the weight of a number of existing features (Kusrini, 2009). Determination of nearest neighbors based on the weight of the similarity of attributes or variables in each case being tested. To determine the similarity of cases in the assessment, use the following steps.

a) Determine the proximity of each attribute, variable or existing features.
b) Calculating the similarity of cases by the similarity function, which is the sum of all the attributes of each case multiplied by the weight of each attribute divided by the total weight of attributes.
c) Once all the data compared to the case and obtained the highest similarity weights, then the data with the highest similarity weight is used as a result.

C. Representation of Knowledge

Prior knowledge is stored into a knowledge base, the knowledge represented using a decision tree and a table of rules. Decision tree can change the fact that a very large tree into the shape that represents the rules to determine a decision. Based on a decision tree can be compiled rules in a table of rules. Each rule in the rule table is based on an attribute, value or values of the attributes and the existing conclusions. Knowledge representation in the decision tree using ID3 algorithm (Iterative Dichotomiser 3). Decision tree is a set of

rules. Then If arranged in the form of decision trees, that every path in the tree are connected by a rule with a premise of fact or set of points (nodes) are encountered with the flow as follows:

1) The tree starts as a single node (root), which represents all the data.
2) Once the root node is formed, then the data on the root node will be measured by information gain to be selected as an attribute that will be the denominator of attributes.
3) A branch was formed from the selected attributes of the divider and the data will be distributed to the respective branch.
4) This algorithm will continue to use the same process or a recursive nature to form a decision tree. When an attribute has been chosen as the node or branch divisor, then the attribute is no longer included in the calculation of the value of information gain.
5) The process of recursive division will stop if one of the following conditions are met.
   - All data from subsidiaries have been included in the same class.
   - All attributes have been used, but the remaining data in different classes. In this case, retrieved data represent the largest class to a class label at the leaf nodes.
   - There is no data on the new subsidiary. In this case, the leaf nodes will be selected at the previous branch and retrieved data representing the largest class to be used as class labels.

Once the knowledge represented, then the knowledge is stored into a knowledge base. Direpresentasu source of knowledge gained through knowledge of documentation written by an expert. Representation of stored knowledge used as the basis for an inference rules in expert systems. Expert system is a branch of artificial intelligence that expand the use of specialized knowledge to solve problems equivalent to human experts (Giarratano & Riley, 1998). In other words, the expert system is a program of giving advice that computerized intended to mimic the process of reasoning knowledge of an expert in solving specific problems.

III. RESEARCH METHODS

A. Research Data

In this study required research materials, research tools and steps in the research.

1) Primary Data
   These data form about the assessment, test materials, assessment procedures, documentation of knowledge, assessment and appraisal system.
2) Secondary Data
   Data obtained through the study of literature and references related to the issue of e-assessment, expert systems, rule base and case base reasoning, programming algorithms and technology used.
3) Knowledge
   Knowledge is a clear perception of something that is acquired through the documentation of knowledge about e-assessment.

B. Knowledge Acquisition Method

1) Manual Methods
   Methods of knowledge acquisition is done by hand knowledge gained through the documentation of knowledge by the knowledge engineer then made coding a program to generate a knowledge base as shown in figure 4.

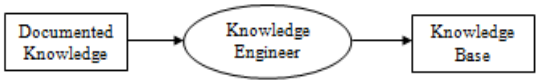

Fig. 4. Manual Methods

2) Rule-Based Reasoning Methods. This method comprising the following stages:
   a) The initial phase by analyzing the problems of a general nature and decompose back problems by dividing a complex public issues into simpler parts. Further problems are evaluated by looking at the relationship between the more specific issues that still fall within the scope of the more common problems. At this stage focuses on extracting information from these sources of information in the form of documentation of existing knowledge.
   b) After further evaluated and compiled the results of the analysis results of extracting information into forms or models that can be implemented into a computer system that is by constructing a decision tree and generates a table of rules as a knowledge representation using the Weka analysis.
3) Case-Based Reasoning Methods.

Methods of knowledge acquisition is done by accessing the problem-solving experiences to predict future problem-solving solutions. This method will be used for calculating similarity and similarity analysis advice. Analysis of case similarities using the nearest neighbor algorithm to calculate the closeness between the new case with the old case. Stages of case-based reasoning as follows.

a. Determine the proximity of each attribute, variable or existing features on the case.
b. Calculating the similarity of cases by the similarity function, which is the sum of all the attributes of each case multiplied by the weight of each attribute divided by the total weight of all attributes.
c. Once all the data compared to the case and obtained the highest similarity weights, then the data with the highest similarity weight is used as a result.

IV. SYSTEM ARCHITECTURE

A. Model E-Assessment With Combination Rules and Case-Based Reasoning.

Design models and application of e-assessment-based knowledge base of web-based expert systems by applying rule-based reasoning on the stage and Preparing and conduct case-based reasoning at this

stage of calculation and advices. Stages of e-assessment framework is adapted according to Almond, Steinberg and Mislevy (2002). While in this study is about the model and application of web-based e-assessement by integrating rule-based reasoning and case. The design of e-assessment model can be seen in Figure 5. This design adapts the framework of e-assessment system according to Almond, Steinberg and Mislevy (2002).

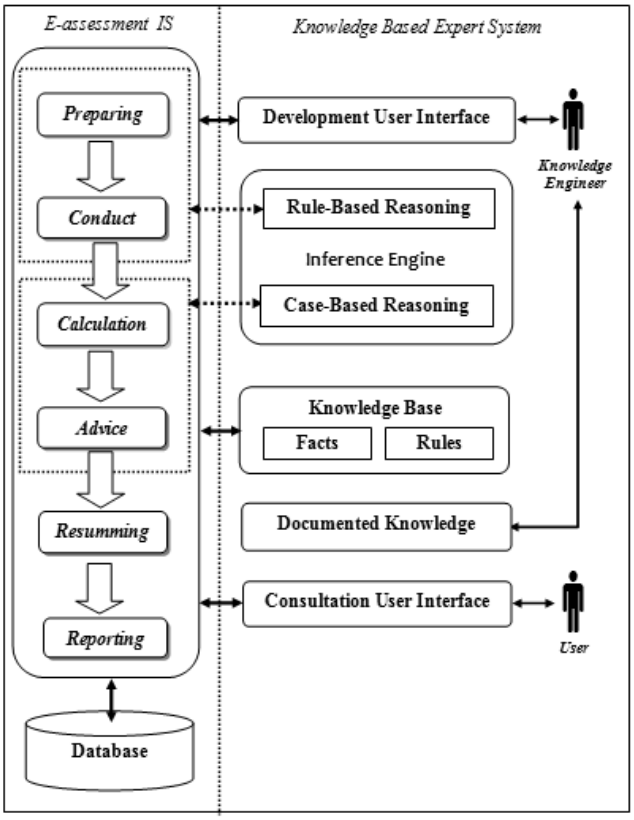

Fig. 4. E-assessment Model of Knowledge-based

E-assessment model based expert systems knowledge base as shown in figure 4. describe the stages of implementation of e-assessment starts from the stage of Preparing, conduct, calculation, advice, resumming reached the stage of reporting. More Stages of e-assessment as follows:

1) Preparation of e-assessment (Preparing). Preparation stage in the implementation of e-assessment activities conducted in the form of making a matter to be presented in the assessment. This type of e-assessment questions are grouped in the form of selection / identification, reordering / rearrangement, substitution / correction, completion and construction (Scalish and Giford, 2006). In the process of making problems, rule-base expert system with rule-based reasoning to guide the selection of assessment about the format that will be made by the examiners or assessors based on the mechanism of rule-based reasoning (RBR) with a forward chaining search method.
2) Implementation of e-assessment (conduct) After the preparation phase is completed, the activity continued with the implementation of e-assessment itself. According to G. Almond, S. Steinberg and J. Mislevy (2002) in the implementation of e-assessment is related to the item about the e-assessment based on pemilihanya strategies can be divided into five types, but in this study will apply two kinds of strategy that is sequential (linear) and choose a random (random selection). In this process of rule-based expert system will guide in choosing the way assessment is done by assesi (students) based on the mechanism of rule-based reasoning (RBR) with a forward chaining search method.
3) Calculate the value of e-assessment (calculation)
   In the calculation of phase values, the results of the implementation of the assessment will be analyzed the answers given. Correct answers will get the value by a certain weight while not getting the answers wrong. Based on the results of the implementation of e-assessment then the capacity of case-base expert system is used here to analyze the similarity between the results of the assessment of e-assessment has ever been done before by the mechanism of case base reasoning (CBR) to obtain predictions and conclusion of the calculation to be used in the delivery phase advice. Calculated values can be distinguished form the two types namely:
   a) Calculate the value of the local scale, namely: the value of the matter at any particular level, a specific group or subject matter specific.
   b) Calculate the value of a global scale, namely: the overall value of the matter is presented in the e-assessment.
   c) Advice of experts in the implementation of e-assessment.

   Assessment implementation advice based on the calculation results in e-assessment. Capacity of an expert system is needed to analyze the similarities here giving advice between the e-assessment has ever been done before on the mechanism of case-base reasoning (CBR) to determine the formulation of expert advice. The suggestions e-assessment can be divided into two kinds:
   a) Local advice : the advice given to the implementation of the assessment at any particular level, a specific group or subject matter specific.
   b) Advice that is global: the advice given to the implementation of e-assessment for the whole group of questions that are presented in e-assessment.
4) Summary of the implementation of e-assessment (Resumming).
   In order for the implementation of the assessment history which consists of the assessment of values and suggestions e-assessment is persistent for future needs then stored in a database as a historical record of e-assessment is undertaken. History can be divided into two, namely:
   a) History of the implementation of assessment for the particular question on any implementation of e-assessment.

b) History of the implementation of e-assessment for the whole group of problems in the implementation of e-assessment.

5) Report on the implementation of e-assessment (reporting).
E-assessment report consists of two kinds of reporting, namely the assessment and reporting advice of an expert system that can be printed.To obtain a picture of e-assessment activity in each of the stages depicted in the block diagram as shown in figure 6.

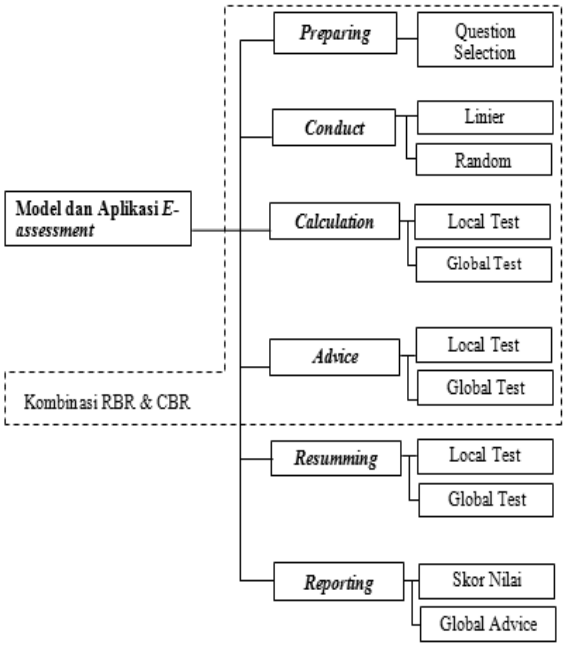

Fig. 6. Block Diagram Models and Applications E-assessment

B. Knowledge Representation and Reasoning-Based Rules In Preparing Phase.

Knowledge is represented in the form of matter according to the format and Giford Scalish (2006). The format consists of about 28 kinds of shapes that are grouped in 7 groups of questions, format questions which represented only the first 4 format plus 6D format. Automated Essay & Editing and formatting 6E. Voice is a new format is added and is presented in Table 1. Knowledge representation format of this problem using a decision tree and a table of rules using Weka and expert systems builder tools.

TABLE 1. TAXONOMY FOR E-LEARNING ASSESSMENT QUESTIONS AND TASKS

1. Multiple Choice	2. Selection / Identification	3. Reaordering / Rearrangement	4. Substitution / Correction	5. Completion	6. Construction	7. Presentation/ Portofolio
1A. True/False	2A. Multiple True/False	3A. Matching	4A. Interlinier	Lainnya		
1B. Alternate Choice	2B. Yes/No With Explanation	3B. Categorizing	4B. Sore-finger			
1C. Conventional or Standard Multiple Choice	2C. Multiple Answer	3C. Ranking and Sequencing	4C. Limited Figural Drawing			
1D. Multiple Choice With New Media Distractor	2D. Complex Multiple Choice	3D. Assembling Proof	4D. Bug/Fault Correction		6D. Essay & Automated Editing	
					6E. Voice	

Based taxonomy for assessment questions and answers in the above table obtained knowledges that can discriptions as follows.

a) Multiple-choice.
Response items to be tested to select the correct answer from a set of answers included in this category. The first category is divided into four kinds of formats
1) True / False.
The format was wrong to give the same alternative for each question of right or wrong answers. The questions presented in the form of a description that contains a statement that is true or false statements and asked respondents to obtain answers to questions are true or false.
2) Alternate choice.
Unlike the format of right / wrong that only have a statement, the format has two alternative options for dintanyakan statement to the respondent that the respondent chose a more precise answer.
3) Conventional or standard multiple-choice.
Multiple-choice format that conventionally has been widely used in the implementation of the assessment. This format has four or five answers with one correct answer. Respondents choose one correct answer.
4) Multiple choice with new media distractor.
Multiple-choice format of the results of innovation with answers responses which generally do not use paper and pencil setting, but the answer selection is done by pressing the mouse button on an image area of graphics, multimedia.

b) Selection / Identification.
This format provides a multiple choice answer options that can be classified as an approach to the selection or identification.
1) Multiple true / false
This format has more than one set of items correct or incorrect answers are used to answer a question. By giving the right answer and wrong answer on item response choices are presented.
2) True / false with explanation
This format has more than one set of items right or wrong answers with explanations on any item to add an answer. Respondents chose the correct answer and the reason why the correct answer, or the respondents chose the wrong answer and the reasons why the answer is wrong.
3) Multiple answer
This format has a set of items available answers, respondents chose more than one correct answer is provided.
4) Complex multiple choice
This format has a set of items available answers, respondents chose the answer is complex.

c) Reordering / rearrangement
About the format that provides a set of response items, respondents chose the answer in a way to reorder or rearrange the answers in order to obtain the correct answer and sequentially.
1) Matching
Format a matter that has a set of pair answers in place adjacent to the left and right. Respondents chose an answer by comparing the answers are on the left lane with answers that are on the right lane.

2) Categorizing
About the format that provides a set of answers, categorize respondents provided answers to the answers that have been provided as well.
3) Ranking and sequenceng
About the format that provides a set of answers, the respondents rank and sort the answers are available.
4) Prepare the truth (assembling proof)
About the format that provides a set of answers, the respondents chose multiple answers for compiled into a statement or sentence that is true.

d) Subtitution / correction
Format matter which provides questions with answers that can be replaced or corrected so that the questions and answers form a correct statement or sentence.
1) Interlinier
Formed about the format of a sentence question, respondents chose some answers that have been provided between the phrase the question to complete the sentence so that it becomes a true sentence.
2) Sore fingers
Formed about the format of a few sentences, respondents chose the answer that has been provided between the sentences about the answers that are marked with an underscore.
3) Limited figural drawing
Formed about the format of an image, adjusting the respondent's conduct or correct the image by setting such a way that the answers provided in accordance with any questions.
4) Bug / fault correction
Formed about the format of an image, the respondent corrected the part of the image to give the correct answer.

Attributes that can be identified from the description above is the type of question format questions, answers, how to answer, multiple choice, selection / identification, reordering / rearrangement, substitution / correction, description, sound and other formats. While the class of these attributes is a matter of format. Based on the attributes and classes are identified structured format about the classification table in Attachment 1. As for the other question formats such as stuffing format (essay), sound (voice) and 3 other groups about the format of the completion, construction and presentation formats are classified into other matter that is not represented, so there are 19 groups about the format can be identified.

With the classification of data will be generated models of buildings that define groups or classes of the deposit data (data records) is tested using the training set to determine the class of the data stored in the training set. Classification in this study using a decision tree classification methods (decision tree) with the algorithm ID3 (Iterative Dichotomiser 3) by Ross Quinlan. To measure whether the class categories derived from the same class or derived from a different class. Measurement of Entropy formula used class category.

$$Entropy(S) = S\ -p(I)\ log2\ p(I)$$
$$Entropi\ (S) = -(p_{+})Log2(p_{+}) - (p-)Log2(p-)$$

S = Set of all samples
p(I) = Proportion of S belongs to class I
p_+ = The proportion of S-Positif
p_- = Proportion of S-Negative
Log2 = Log base 2

Entropy is 0 (zero) if all members of S are from the same class (complete data classification), while the entropy of value 1 (one) if all the members of S comes from a different class (the data is completely random). To obtain the value of performance information (information gain) of an attribute in the training data set S is defined as follows :

$$Gain(S, A) = Entropy(S)-S((|Sv|/|S|) \times Entropy(Sv))$$

(S, A) = Each of all possible values of v from attribute A in S
Sv = subset of S for which attribute A has value v
| Sv | = Number of elements in Sv
| S | = number of elements in S

Using the ID3 classification algorithm, then tested as many as 70 items of data about the format of questions (as in appendix 1) which consists of 19 different formats you will get a decision tree structure, with the following stages.

1. Make as many as 70 a matter of training data (representing all formats) and 11 attributes with a comma separated value format (. Csv).
2. Using analysis software Weka, 70 questions and 11 attributes which are then processed to obtain the pattern of class using ID3 algorithm as shown in figure 7.

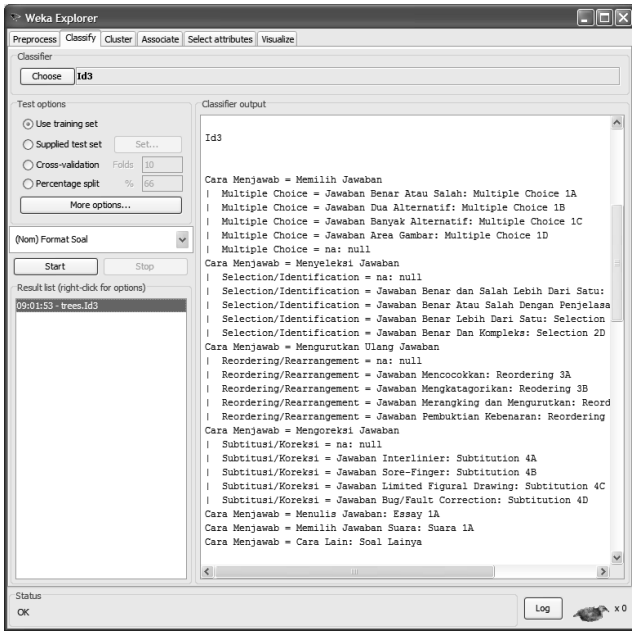

Fig. 7. Classification of Questions Format

Produces the output as follows.
Scheme: weka.classifiers.trees.Id3
Relation: Decicion_Table v5
Instances: 70
Attributes: 11

Jenis Soal
Jawaban
Cara Menjawab
Multiple Choice
Selection/Identification
Reordering/Rearrangement
Subtitusi/Koreksi
Uraian
Suara
Lainya
Format Soal

Test mode: evaluate on training data

=== Classifier model (full training set) ===

Cara Menjawab = Memilih Jawaban
| Multiple Choice = Jawaban Benar Atau Salah: Multiple Choice 1A
| Multiple Choice = Jawaban Dua Alternatif: Multiple Choice 1B
| Multiple Choice = Jawaban Banyak Alternatif: Multiple Choice 1C
| Multiple Choice = Jawaban Area Gambar: Multiple Choice 1D
| Multiple Choice = na: null
Cara Menjawab = Menyeleksi Jawaban
| Selection/Identification = na: null
| Selection/Identification = Jawaban Benar dan Salah Lebih Dari Satu: Selection 2A
| Selection/Identification = Jawaban Benar Atau Salah Dengan Penjelasan: Selection 2B
| Selection/Identification = Jawaban Benar Lebih Dari Satu: Selection 2C
| Selection/Identification = Jawaban Benar Dan Kompleks: Selection 2D
Cara Menjawab = Mengurutkan Ulang Jawaban
| Reordering/Rearrangement = na: null
| Reordering/Rearrangement = Jawaban Mencocokkan: Reordering 3A
| Reordering/Rearrangement = Jawaban Mengkatagorikan: Reodering 3B
| Reordering/Rearrangement = Jawaban Merangking dan Mengurutkan: Reordering 3C
| Reordering/Rearrangement = Jawaban Pembuktian Kebenaran: Reordering 3D
Cara Menjawab = Mengoreksi Jawaban
| Subtitusi/Koreksi = na: null
| Subtitusi/Koreksi = Jawaban Interlinier: Subtitution 4A
| Subtitusi/Koreksi = Jawaban Sore-Finger: Subtitution 4B
| Subtitusi/Koreksi = Jawaban Limited Figural Drawing: Subtitution 4C
| Subtitusi/Koreksi = Jawaban Bug/Fault Correction: Subtitution 4D
Cara Menjawab = Menulis Jawaban: Essay 1A
Cara Menjawab = Memilih Jawaban Suara: Suara 1A
Cara Menjawab = Cara Lain: Soal Lainya

C. Knowledge Representation and Reasoning Based Rules In Phase Conduct.

Implementation of the assessment can be divided into two kinds of assessment methods, namely linear and random. Assessment is linear in its implementation, the issue presented in sequence based on the assessment level by combining the initial stages of assessment given the name of the attribute level 1, the stages between the beginning and end of the assessment given the name of the attribute level 2, while in the final stages of assessment given the name of the attribute level 3. Linear stage has two possible ways, the first possible assessment starts from level 1, then level 2 and level 3 as the final stage of assessment, while the possibility of starting a second assessment of the level 3, then level 2 and level 1 as the final stage.

Assessment presented in random sequence or random is not based on a combination of Level 1, Level 2 and Level 3 are presented at random with four different possibilities. Assessment Method with linear and random phases can be seen in table 2.

TABLE 2. RULES ASSESSMENT METHOD

Phase 1	Phase 2	Phase 3	*Assessment*
Level 1	Level 2	Level 3	Linier A
Level 3	Level 2	Level 1	Linier B
Level 1	Level 3	Level 2	Random A
Level 2	Level 3	Level 1	Random B
Level 3	Level 1	Level 2	Random C
Level 2	Level 1	Level 3	Random D

With the ID3 algorithm, will then be tested with training data of 40 data using Weka software.

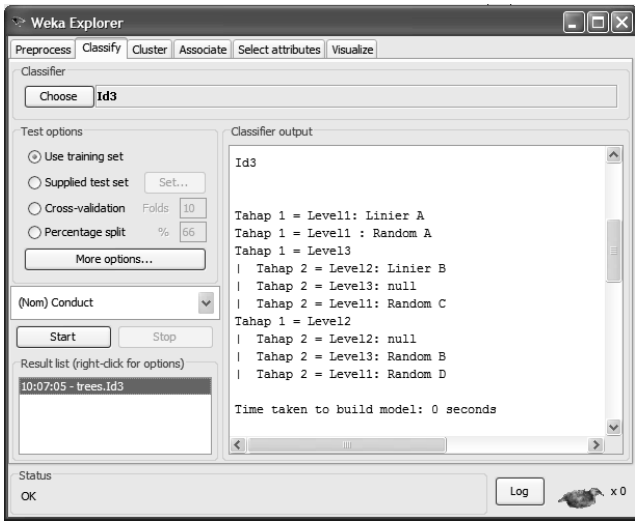

Fig. 8. Classification Assessment Method

Processing results in figure 8. looks a pattern similarity between Random A and Linear A, if the outcome at stage 1 is equal to level 1, then summed up as Random A or Linear A, thus there are two different conclusions for the same facts. This condition is necessary fixes the rules by adding a new fact patterns that can distinguish different rules to generate a conclusion. The results of data processing training with the ID3 algorithm as follows.

Scheme: weka.classifiers.trees.Id3
Relation: Conductv2d
Instances: 40
Attributes: 4
Phase 1
Phase 2
Phase 3
Conduct
Test mode: evaluate on training data

=== Classifier model (full training set) ===

Phase 1 = Level1: Linier A
Phase 1 = Level1: Random A
Phase 1 = Level3
| Phase 2 = Level2: Linier B
| Phase 2 = Level3: null
| Phase 2 = Level1: Random C
Phase 1 = Level2
| Phase 2 = Level2: null
| Phase 2 = Level3: Random B
| Phase 2 = Level1: Random D

With the improvement of the rules of the decision tree in Figure 7, the obtained results improved decision tree structure as shown in Table 3, the following improvements:

1) To obtain the conclusion of Linear A, then add an attribute with a value of Phase 2 Level 2.
2) To obtain the conclusion Random A Phase 2 then added attribute with a value of Level 3. So it can be compiled rule table means assessment as in table 3

TABLE 3. TABLE RULES ASSESSMENT METHOD

Knowledge Base Rules for Rule Based *Assessment* Expert System	
#	Rule
1	If phase 1 = level 1 and phase 2 = level 2 then *Assessment* is Linier A.
2	If phase 1 = level 1 and phase 2 = level 3 then *Assessment* is Random A.
3	If phase 1= level 3 and phase 2 = level 2 then *Assessment* is Linier B.
4	If phase 1 = level 3 and phase 2 = level 3 then *Assessment* is Null1.
5	If phase 1 = level 3 and phase 2 = level 1 then *Assessment* is Random C.
6	If phase 1 = level 2 and phase 2 = level 2 then *Assessment* is Null2.
7	If phase 1 = level 2 and phase 2 = level 3 then *Assessment* is Random B.
8	If phase 1 = level 2 and phase 2 = level 1 then *Assessment* is Random D.

D. Case-Based Reasoning In Phase Calculation.

Analysis of case data calculated similarity assessment has been done before with new cases, nearest neighbor algorithm is used. Nearest Neighbor is an approach to search for cases by calculating the affinity between the new case with an old case, which is based on matching the weight of a number of existing features (Kusrini, 2009). To calculate the overall accumulative distance variable in the case of similarity assessment and then use the formula (T, S) to calculate the value of the accumulated weight of the proximity of the variable between the cases in the assessment. Formula to calculate the similarity of cases, use the formula.

$$similarity(T,S) = \frac{\sum_{i=1}^{n} f(T_i, S_i).\ w_i}{w_i}$$

T : The new Case
S : The case is in storage
n : number of attributes in each case
i : Attributes of individuals between 1 s/d n
f : Function attribute similarity between the cases of Ti and S
w : The weight given to attribute to i

The closeness between the new case with the old cases have a value range between 0 and 1. A value of 0 indicates that the case is absolutely not similar,

whereas a value of 1 indicates that the case is absolutely similar (Kusrini, 2009). The case on the issue of calculating the value of assessment is assumed to have the attributes as shown in table 5. These attributes are Assessment, Level, Type of Assessment, Total Questions, Answer True, False Answer, Values, and Status.

Each attribute in the classification table set value weighting each with a weighting value between 0 and 1 based on the consideration of the overall levels of attributes. The weight attribute is set as follows.

Atribut Assessment = 0,6
Atribut Level = 0,5
Atribut Jenis Penilaian = 0,5
Atribut Jumlah Soal = 0,5
Atribut Jawab Benar = 0,75
Atribut Jawab Salah 0,75
Atribut Nilai = 0,75
Atribut Status = 0,5

Stages of testing similarity assessment cases using Weka software as follows:

1) Make as many as 16 training data items calculated results (16 data template or the old assessment data and 3 new assessment data).
2) Using the software Weka, 16 items calculated results, 8 attributes and 3 items of new cases are then classified to obtain the similarity between the three new cases and 16 old cases that have been stored in a database by k-nearest neighbor algorithm like the figure 8.
3) Through this stage the resulting output processing results with the nearest neighbor algorithm is a classification of new cases by the similarity between the old case. Resemblance to the predicted results of data-17 similar to the data to-4 (FL2_Gagal), data similar to the 18 th to the data-7 (SL1_Lulus) and data to the 19 similar to the data to-14 (FG_Gagal) as in Figure 8.

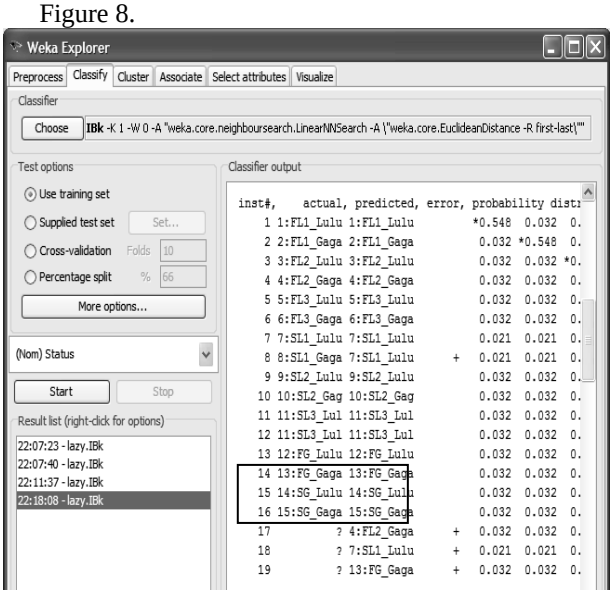

Fig. 9. Format Questions with Weka

Based on the test results in figure 9, the third item of new cases can be predicted accurately through calculating the similarity with assessment data that has been done before. Table 4. shows the calculation results with the formula similarity Similarity (T, S) using four examples of assessment data (1 new data and old data 3) to compare the similarity between the four data.

TABLE 4. *WEIGHT VALUE CALCULATION RESULTS OF SIMILARITY.*

No	Comparative Assessment	Weight Similarities	Percentage Similarities	Description
1	4 and 1	0,7494	74,94%	Nearest Top-3
2	4 and 2	0,8701	87,01%	Nearest Top-2
3	4 and 3	0,9879	**98,79%**	Nearest Top-1

E. Case-Based Reasoning In Advice Phase.

Calculations are based on the value assessment has been done before these suggestions can be formulated in the implementation of assessment. Analysis of similarity data for the suggestions long case assessment with a case of a new assessment also uses nearest neighbor algorithm with Similarity formula (T, S).

TABLE 5. *TEMPLATE* OF *ASSESSMENT ADVICE*

Assessment	Level	advice type	Score	Advice
Formatif	1	Local	100.00	SF1L
Formatif	1	Local	40.00	SF1G
Formatif	2	Local	60.00	SF2L
Formatif	2	Local	25.00	SF2G
Formatif	3	Local	65.00	SF3L
Formatif	3	Local	50.00	SF3G
Sumatif	1	Local	90.00	SS1L
Sumatif	1	Local	50.00	SS1G
Sumatif	2	Local	80.00	SS2L
Sumatif	2	Local	45.00	SS2G
Sumatif	3	Local	75.00	SS3L
Sumatif	3	Local	20.00	SS3G
Formatif	0	Global	60.80	SF0L
Formatif	0	Global	33.33	SF0G
Sumatif	0	Global	78.40	SS0L
Sumatif	0	Global	41.00	SS0G

Based on Table 5. formulation suggestions are grouped based on assessment criteria assessmen type, level of assessment, types of assessments, and value. The suggestions are assumed based on the criteria according to the material on test and the assessor's opinion. Examples of the suggestions in the assessment describes as follows.

a) Proposed SF1L: Suggestions for the implementation of formative assessment for Level 1 with the type of advice is LOCAL. The value obtained is 100, then you PASS. Assumption Tip: All about done with perfect (100%), preparing for exams the next level.

b) Advice SF1G: Suggestions for the implementation of formative assessment for Level 1 with the type of advice is LOCAL. The value obtained is 40, then you FAIL. Assumptions Suggestions: Questions done right 40%, 60% wrong, Learn Chapter 1 and Chapter 2 is more comprehensive.

Each attribute value is set by the weight of each weight value between 0 and 1. Attribute weights can be seen in table 6.

TABLE 6. WEIGTH OF ATTRIBUTES

Assessment	Level	Score Type	Score	Advice
0,60	0,50	0,50	0,75	0,50

After weighting table set next nilainnya tested with training data cases as many as 16 items calculated assessment, 8 attributes and 2 items of new cases. The steps to determine the proximity of case classification calculated as described as follows:

1) Make as many as 16 training data item, 5 attributes and 2 items of new cases.
2) Using the software Weka, 16 items calculated results, 5 attributes and 2 items of new cases are then classified to obtain the similarity between the two new cases with 16 cases of old stored in the database with the nearest neighbor algorithm.
3) Through this stage the resulting output processing results in the form of classification of new cases by the similarity between the old case. Menunujukkan analysis results that the prediction for-17 data to similar data to-2 (SF1G) and data to-18 similar to the data to-9 (SS2L) as in Figure 10.

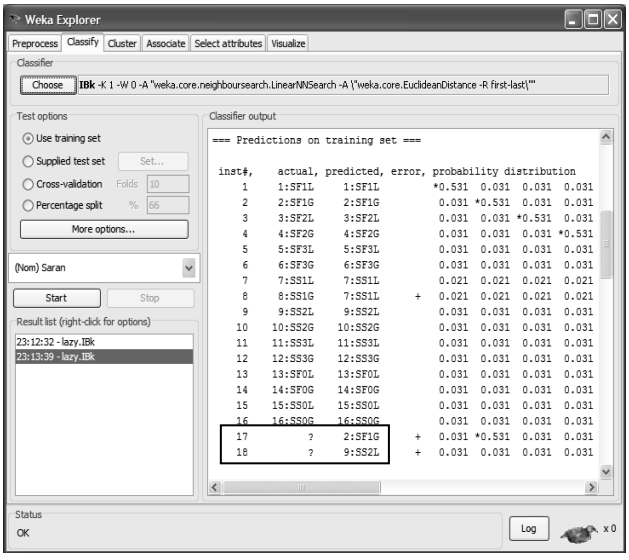

Figure 10. Testing Results Data Assessment Recommendations

V. SOFTWARE DEVELOPMENT

Software development of e-assessment using the method of Rational Unified Process (RUP). Stages in RUP consists of four phases consisting of inception, elaboration, construction, and transition.

a) Inception Phase

In this phase established the vision and scope of software projects are depicted in the diagram usecase business and system usecase. To understand the e-assessment system which consists of e-assessment systems engineering and systems engineering expert in e-assessment it is necessary to design a business model in that context. Asessor actors have a responsibility in managing assessment consists of class Enroll activity, add asessi, developing question, calculating assessment, delivery advice, assessment reporting. While the actor assesi have a responsibility in conducting assessment consists of subscription activity assessment, conduct of assessment, report and Obtain Obtain advice. Usecase business model of e-assessment by applying rule-based expert system and the case can be described in business usecase diagram as shown in figure 10.

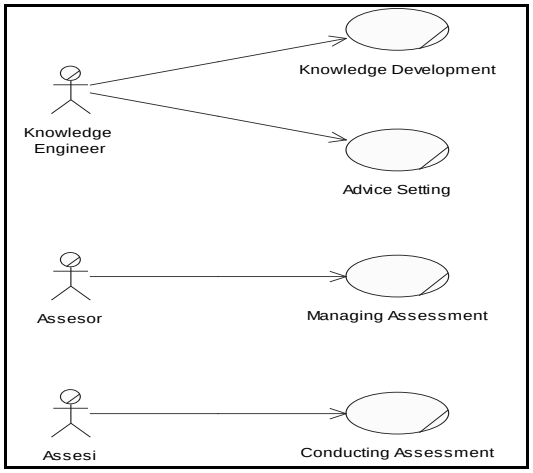

Fig. 11. Business Usecase E-assessment System

Further functionality in business usecase decomposition of functions carried out to obtain more detailed usecase diagram thus obtained is also picture a more detailed system functionality as illustrated in figure 12 usecase diagram of the system.

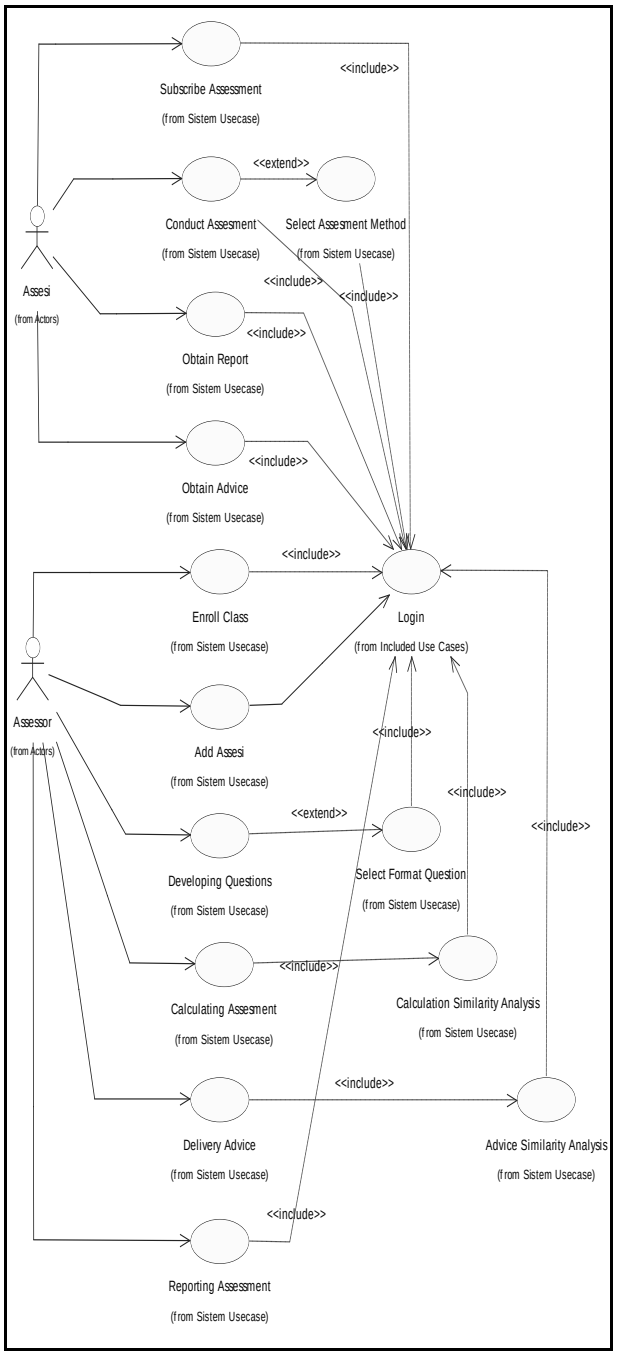

Fig. 12. System Usecase of e-assessment System

b) Elaboration Phase

In this phase focused on what will be achieved in software design and how it can achieve the goal of designing software. System functionality is realized in the process scenarios that illustrate how the functionality is in the doing. By describing a process flow of the system functionality will be known actors, objects and artifacts within the system that collaborate to execute a system functionality in detail. Activity or process can be described using the activity diagram.

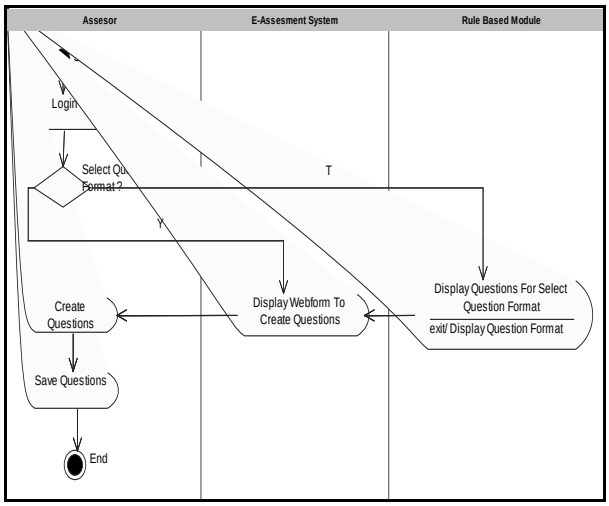

Fig. 13. Activity Diagram of Development Questions

c) Construction Phase

At the construction stage is focused on the design in more detail about the implementation of the interface design, integration of system components, coding and implementation of the system. At this stage also the integration of system modules do. System implementation is limited to 4 (four) modules, namely module rule base at this stage of Preparing and conduct a dialogue between the user interface with the system, while the module base case at this stage of calculation and advice in the form of interface that displays the weight information closeness cases through similarity analysis of cases and value calculations the suggestions.

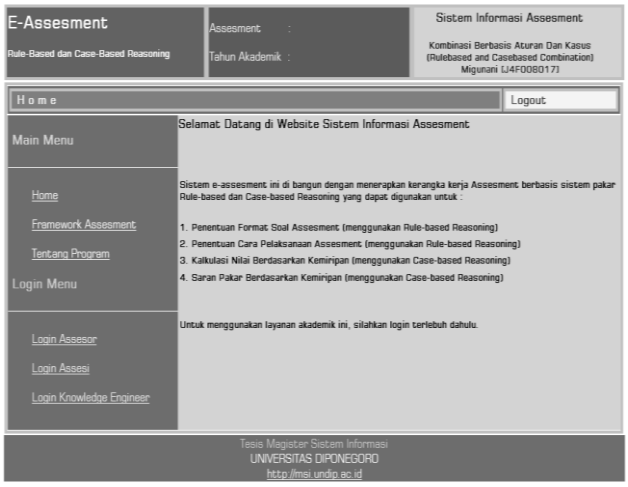

Fig. 14. Application Prototype Interface

d) Transition Phase.

At the phase transition is the activity conducted testing to find bugs / errors or to enhance the reusability of software. In this phase also conducted training for software users and the preparation for the installation of the software. Methods of software testing using black box testing techniques. Black box testing focuses on the functional specification of the software by defining a set of input conditions and perform

testing in the functional specification. One test is to test the functional specification of system requirements or needs

TABLE 7. REQUIREMENT FOR QUESTION FORMAT SELECTION

Name	**Select Format Question**
Requirement	Choosing the format of the question by the method of rule base
Precondition	This page displays a dialog webform
Steps	Click the radiobutton choice of yes or no
Expected Results	1) If it works about the format type is displayed 2) If this fails an error message will appear

TABLE 8. REQUIREMENT FOR CONDUCT ASSESSMENT

Name	**Conduct of *Assessment***
Requirement	Carry out the assessment
Precondition	Halaman menampilkan webform dialog
Steps	This page displays a dialog webform
Expected Results	1) If it works the way assessment is shown 2) If this fails an error message will appear

TABLE 9. REQUIREMENT FOR CALCULATION SIMILARITY ANALYSIS

Name	**Calculation Similarity Analysis**
Requirement	Analysis of similarity calculation
Precondition	Form analysis showing the similarity calculation
Steps	Click the button of the similarity calculation anaysis
Expected Results	1) If it works the way assessment is shown 2) If this fails an error message will appear

TABLE 9. REQUIREMENT FOR ADVICE SIMILARITY ANALYSIS

Nama	**Advice Similarity Analysis**
Requirement	Analysis of similarity advice
Precondition	Form analysis showing similarity of advice
Steps	Click the button of advice similarity analysis
Expected Results	1) If it works the way assessment is shown 2) If this fails an error message will appear

VI. CONCLUSIONS

1. The combination of rule-based reasoning and case-based reasoning can be used to design models and application software are adequate for e-assessment at this stage of Preparing, conduct, calculation and advice. Through the rule-based reasoning method can generate a table of rules for classification problems and ways of assessment formats as new features are in included in the e-assessment system.
2. Case-based reasoning with the nearest neighbor algorithm can effectively find the weight of the closeness between the calculated value of the records assessment and suggestions for the implementation of the assessment that generates predictions on the status assessi success in the assessment and for the formulation of suggestions after the implementation of the assessment. Nearest neighbor algorithm used in the calculation stage and advices will be more effective when it is available the records with the basic patterns that represent all the possible outcomes of the status of assessment or assessment suggestions as template data.

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