



## Rule Based Expert System for Supporting Assessment of Learning Outcomes

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### ABSTRACT

At present all fields have received support from the sophistication of technology with the rule base concept. In the world of education which certainly influences the teaching and learning process and assessment in order to determine the quality of university graduates. At Raharja University, learning systems such as integrated learning (iLearning) have been applied to achieve the objectives of a learning and that supports the assessment learning process but learning outcome. Students are given the opportunity to experience learning by using the iLearning which is a learning process based on the Ten Pillars of Information iLearning (TPI) media. However, in previous learning using iLearning was considered less effective where the assessment to learning outcome is not based on applicable rules, or does not have a definite reference in assessing student assignments. Therefore, in this paper, the researchers develop a rule based expert system for supporting assessment of learning outcome in order the learning system will be more effective and can be used to assess the quality of each student at University. The expert system was built using a forward chaining method. The observation and direct research on the assessment of student learning outcomes that combine assessment automatically and manually. The results of the testing system are expected to be that the expert system in this research is able to support assessment of learning outcomes based on rule based to be able to give results that are precise, correct and quality.

**Key words:** Rule base, expert system, forward chaining, and ilearning.

### 1. INTRODUCTION

The development of information technology in online learning must be supported by information that can support online teaching and learning activities, without obstacles to getting information students can access data

independently about information related to college activities [1]. iLearning Education (iDu) is part of the Ten Pillars of iLearning that adopts the benefits of ICT, developed by Raharja University Online based on a cloud-based Learning Management System (LMS) hosted by users without the need to install or download software or applications that are considered to facilitate the campus community and students in do lectures [2].



Figure 1: Learning Management System Concept

The use of LMS combined with the concept of an expert system of basic rules with the method of forward chaining, in addition to helping users or students who can learn the material interactively, and assisting the instructor in seeing the progress of user expertise, for this lecturer can also provide convenience in assessing student assignments. This is considered to be more interactive which means that users can apply the knowledge learned and also get immediate feedback [3].

In Mahaman [4], the undergone research on an expert system, are based on rules for conducting integrated pest management. In the research, he agreed to represent knowledge in the form of IF-THEN linguistic rules. This expert system is considered to have provided an evaluation of the expert system that is still conventional [4]. As for other studies that discuss expert systems with forward chaining techniques which are then combined with rule-based reasoning, it is used as a concept of combining the diagnosis of pests and diseases in chili [5].

Subsequent research [6], have discussed a web-based expert system for harvesting wheat in Pakistan. The Expert System applies rules based on two main classes of problems with disease and pests. The system gives a very precise output of results, and is considered to be very consistent. Based on the description and research that has been there before, the author makes the application of expertise that can be used as a student assignment grading system by applying the chaining rule base forward chaining method. In this paper discusses the development of expertise software used on websites to support learning and assessment of tasks accessed by students and lecturers.

**2. RESEARCH METHOD**

To collect data in this study, observation technique is used that is to go directly to the field to observe and examine the assessment of an assignment in the academic sphere, that is online learning through the media LMS also conducts interview sessions with relevant speakers to be able to provide an assessment with the concept of rule base forward chaining [7].

There are previous studies conducted in line with the Literature Review about the concept between assessment and technology. In an effort to develop an assessment system on a LMS using the concept of rule base forward chaining, the authors conducted a literature study in this study as one of the applications of the research method to be carried out [8]. Among them is identifying gaps and methods that have been done before, also continuing research that has been carried out, and to find out others who have the same specialization and research area in this field [9].

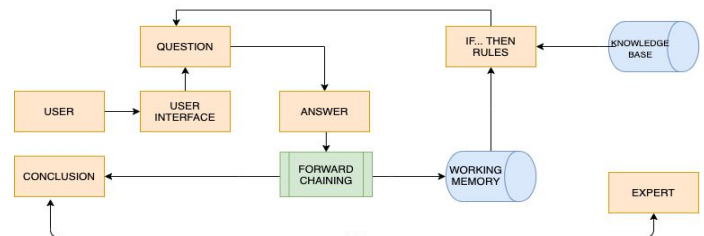
The first research [10]. Explained that the performance of lecturers was assessed from 4 aspects namely: carrying out education and teaching, conducting research, community service, as supporting elements of

lectures. Further research [11] discussed the application of a new rule based system that is a system called extended belief rule based (EBRB). It has the concept of combining structure learning and parameter learning or as joint learning to improve the system of EBRB.

Other research [12] have discussed the influence of the gamification method which is very significant not only in terms of students but supporting lecturers also find it easy to award student test scores which previously occurred due to inaccuracies due to inaccuracies in the data used to be more timely and accurate in terms of data. The other report discussed the use of the rule base expert system concept using the Rapid Application Development (RAD) design method with the User Acceptance Testing technique. With the results that the rule base system can show indications of illnesses suffered by children and their solutions with very precise results [13]. In line with the research cited earlier, the authors take an outline that a system using a rule based expert system is able to identify or solve problems with more precise and accurate solutions. It is expected that by combining it with the LMS learning system it can produce good solutions [14].

**3. RESULT AND ANALYSIS**

Development in an application of expertise should be made based on expert system components as a basic or main component that must be present, namely a good user interface, inference engine, and knowledge base [15]. This expert system architecture was built in part based on a knowledge base, database, inference engine, users and experts. The following is an overview of what systems build expert systems [16].



**Figure 2:** General description of expert systems

Calculation of the results with forward chaining consists of several steps, namely knowledge base, inference engine, working memory and user interface. Knowledge base in expert systems is a representation of knowledge from an expert that needs to be understood, to formulate and solve problems that are converted into rules so that they can be understood and processed by the system [17]. Knowledge base contains knowledge in problem solving.

This knowledge base also contains rules relating to that knowledge. In this process knowledge is represented as a knowledge base and the rule base is then coded, collected, and formed systematically.

There are several ways to represent data into a knowledge base in the form of attributes, rules, meticulous networks, frames, and logic. There are two main elements of the knowledge base, namely fact and special heuristics. Fact, is a situation (theory) related information, and special heuristics, or rules, directly use knowledge to solve certain problems.

In this research, the Rule Based on expert system is rule-based reasoning, knowledge is represented using rules in the form of: IF-THEN. This form is used when our model has some expert knowledge on a particular problem and the expert can solve these problems about assessment sequentially. When new knowledge is found that has to be inputted or edited, then the whole program has to change and requires a lot of time inference Machines to retrace program listings. So the creation of an expert system with several knowledge bases needs to pay attention to how to store the right storage so that the data table for storing that knowledge can be well organized for some knowledge.

The otherside, Inference Engine is determining the rules/problems of existing assessment with forward chaining based search methods. Inference is a process used by expert systems to produce new information from information that is already known. Rule based expert systems in this research is the inference process is carried out in a module called an inference engine. The engine inference functions are: give questions to the user, add the answer to working memory (blackboard), add new facts from a rule (inference results), add the new facts to working memory, and matching facts to working memory with rules. In this research, all of the functions are about the assessment to learning outcome.

Search mechanisms in this way will analyze a particular problem that is described based on the facts that appear and then traced to find solutions to answers or conclusions with the best criteria. This mechanism will gather the facts that are seen and obtained during the Q & A process with the user, and the use of rules stored in a database of rules known as knowledge base, the inference engine can draw a conclusion and provide a recommendation or suggestion that the user needs.

In general, the forward reasoning inference (Forward Chaining) rules will be tested one by one in a certain order. When each rule is tested, the system evaluates whether the condition is true or false. In other words, reasoning starts from the facts first to test the hypothesis. Forward chaining is data driven because inference starts with the information available and then a conclusion will be obtained. In expert systems generally the reasoning or

inference engine method is implemented in the form of coding lines in a particular programming language. Then it can be expected that an expert system with some knowledge can only be filled with a few expertise that have the same inference technique and have the same knowledge base structure.

Determine the rules of the assessment of existing student assignments with a forward chaining based search method. Using an inference engine that is used as the brain function of the application of expertise, in this section there is a mechanism with a function to reason / think and has a pattern of reasoning system used by an expert [18]. The search mechanism used in this way will analyze a particular problem that is described based on the facts that are thereafter to be traced in finding solutions to answers or conclusions with the best criteria [19].

Working Memory is part of an expert system that is used to record ongoing events including temporary decisions. This section contains the facts of the problem found in a process. These facts come from consultations. The structure of working memory will follow the expert system inference flow. Then, User Interface. In this section is a mechanism or medium of communication between users (users) with the program. This section also provides and provides information facilities and some information that leads to tracing the problem until a solution is found.

#### 4. DISCUSSION.

In order to deal with the problems that have been explained before, it is necessary to have an implementation process of an assessment system that is able to support the learning contained in the LMS classes.

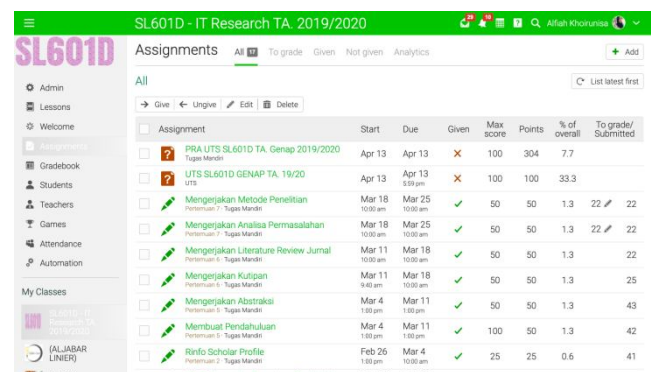


Figure 3: Student assignment view

This expert system knowledge comes from a variety of sources, including interviews and observations with lecturers at Raharja University and scientific research journals that discuss the same field of science, namely the LMS as well as the rule base expert system [20]. In Figure 2 the attribute of information contained in this system consists of questions, answers, question points, score scores, gamification points, and grade of overall

score total assignments that have been done by students. The value of this membership function will be used as a reference in calculating the assessment process.

**Grading scale**

This assignment is using the default class grading scale: Standard regul:

Grade	Minimum%	Letter%
A+	95	97.5
A	90	92.5
A-	85	87.5
B+	80	82.5
B	75	77.5
B-	70	72.5
C+	65	67.5
C	60	62.5
C-	55	57.5
D	50	52.5
F	45	20

**Figure 4:** Scale grading table found in Learning Management System (LMS)

Figure 3 is a grade calculation table in the LMS system that uses the assessment automatically concept, used to assess student assignments in the form of quizzes or other independent assignments. The table above contains a combination of rules as a requirement to produce grading outputs that will produce results according to the value of the student assignment. The rule base system used this time is a rule-based system, if expressed in If-Then statements that are relevant to static from the start of the system in the form of data and conditions [21]. All actions that need to be taken to resolve the problem are based on facts. The rules link facts in IF with actions in the THEN section [22]. Here there are 4 (four) rules that are used to produce output in accordance with the grade table in the LMS system.

**Table 1:** Variable Qualification Rule

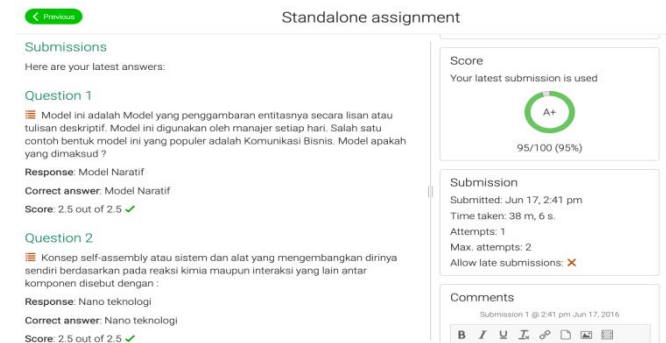
Rule	Qualification	Grade
R1	Right Answer = 43 - 50	A+ > 95
	Score (Right Answer x 2) = 86 - 100	A > 90 < 95 A- > 85 < 90
R2	Right Answer = 35 - 42	B+ > 80
	Score (Right Answer x 2) = 70 - 84	B > 75 < 80 B- > 70 < 75
R3	Right Answer = 28 - 33	C+ > 65
	Score (Right Answer x 2) = 56 - 66	C > 60 < 65 C- > 55 < 60

R4	Right Answer = 25	D > 50 < 55
	Score (Right Answer x 2) = 50	
R5	Right Answer = 22	F > 45 < 50
	Score (Right Answer x 2) = 44	

**Table 2:** Rule implementation

<b>ULE 1:</b> IF Right Answer = 47 AND Score = 94 THEN Grade = A	<b>RULE 3:</b> IF Right Answer = 30 AND Score = 60 THEN Grade = C
<b>RULE 2:</b> IF Right Answer = 41 AND Score = 82 THEN Grade = B+	<b>RULE 4:</b> IF Right Answer = 27 AND Score = 54 THEN Grade = D

In this expertise system design uses forward chaining reasoning model technique (forward tracking) which is a method or technique that starts with the input of a set of facts related to a symptom answered by the user as an expert input system, then tracking procedures are carried out such as conducting a fire rule (fact selection in the production system) to the final destination through a link that is packaged in the form of a diagnosis with the results of the possibility of skin disease suffered by patients [23]-[25].



**Figure 5:** Output Grade on student assignments

Figure 5 made an informed decision about the results or output of the rule based expert system support assessment of learning outcome with the forward chaining. Implementation of rule based concept of forward chaining can be compared with the previous assessment system. The rule based expert system was made with experts and can be concluded that the rule based expert system for supporting assessment learning outcomes using the rule

base forward chaining concept can provide the right, correct and consistent assessment of the facts or grades produced by students. Results of the rules based expert system in this result in line with similar research [26] which is to quantify the performance of various grade alternatives. The other hand, the rules based expert system in this research adopts a concept that assesses that knowledge with a rule-based knowledge base [27]-[30].

## 5. CONCLUSION

In this paper, a rule based expert system has been developed for supporting assessment of learning outcome. This is an improvement from previous studies about the assessment learning outcome in the Learning Management System is investigated. Based on the results of testing of the rule based expert system for supporting assessment of learning outcome in this research, it can be concluded that the system that is currently running is considered to be very both can support to assess learning outcome. It is including the work of lecturers to run the material that will be submitted to students. The system provides an assessment using two variables. It is namely the correct problem and score. Moreover, assisted by the application of the rule based expert system in this research is proven to facilitate lecturers in assessing student assignments, with the concept of forward chaining which helps in finding data that is in accordance with facts.

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