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Designing an expert system for determining student learning styles using forward chaining in engineering education

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ABSTRACT

Engineering education prepares its graduates able to work in the community and entrepreneurship, the quality of graduates is highly determined by the quality of the learning process is no exception for student learning styles. The purpose of this study was to describe the design of the expert system to determine the student learning style, the method used was forward chaining. The results of the design of this application have been able to diagnose student learning styles efficiently and provide the best solutions for their learning.

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Introduction

Engineering education is an education that prepares graduates to be prepared and able to work in the world of work (Ganefri et al., 2017; Tasrif, 2019; Anwar, 2021). Not only ready to work but with the competence possessed by a graduate of engineering education, required to be able to open employment (Hidayat et al, 2019a, 2019b, 2019c; Hidayat et al., 2020), and entrepreneurship (Ganefri et al., 2018; Hidayat, 2017a, 2017b; Hidayat, & Yuliana, 2018; Hidayat et al., 2018a, 2018b). The challenges of global competition and the digital era demanding higher education more seriously to prepare graduates of engineering education (Tasrif et al., 2021). Preparedness and quality graduates are highly determined by the learning process (Anwar, 2019), Learning Model (Hidayat, 2015; Aryanti, Anwar, & Zulwisli, 2017; Andrianis, Anwar, & Zulwisli, 2018), and management quality management (Tasrif, 2019). Learning is a process of change in the human personality and these changes are dumped in the form of improving the quality and quantity of behavior such as increasing knowledge, emotional increase, behavior and habit (Pane, 2017; Tasrif et al., 2020). Learning is not just to study general science, but with learning, individual behavior is better (Sari, 2014; Pane, 2017). Individuals who experience a learning process will get a change in which he also did not know to know that it formed a quality human being (Sari, 2014).

The teaching and learning process that occurs is like a flashlight that is reflected in the wall (sari, 2014). In the learning process should be the speed of the student brain capturing information from the teacher is 1,287 km / h the same as the speed of light coming out of the flashlight. If the statement is correct, why is there still many failures in the learning process. Previous research states that there are many factors that influence student failure in learning, one of which is learning style. We all have a learning style, the same unique thinking style with our fingerprints. We each receive information, save knowledge and retrieve it again in different ways. The statement explains that every individual is born with its own uniqueness which they have differences in each other. Like physical differences, mindset, how to respond and remember new

things. No exception for students, they have their own way of compiling what has just been learned to be remembered by the brain.

Learning styles are interpreted as individual preferences who are rooted for the type of learning in each individual (Vorhaus, 2010; Felder et al., 2000). For example, how to fold your hands. Every individual has each way to fold your hands. Likewise with theory and style of learning, there is someone who prefers to learn something with pictures and diagrams and some who prefer the words (Vorhaus, 2010), is no exception also in engineering education. The learning style in technical education certainly has a particular uniqueness and characteristics (Felder, & Silverman, 1988).

Artificial intelligence is defined as a machine that is able to think, weigh the actions to be taken, and able to make decisions such as those carried out by humans (Akil, 2017; Harjanto, Karnila, and Nugraha, 2018). Intelligence is inserted into the computer in order to do work as a human can do. Some areas that use artificial intelligence include expert systems, computer games (games), fuzzy logic, artificial neural networks, and robotics. An expert system is a system that is able to imitate the reasoning of an expert so that computers can solve problems as usual by experts (Sari, 2013; Waliyansyah, Novita, and Aditasar, 2020). The important role of an expert can be replaced by a computer program which is on the principle of work to provide a sure solution as usual by experts. Expert systems are usually used for consulting, analysis, diagnosis, and help make decisions.

Determination of learning styles with certain methods and methods have been carried out in previous studies and provide good results, such as predictions of learning styles with Fuzzy Decision Trees (Kanninen, 2009; Hsu, Wang, & Huang, 2010; Latham et al., 2012; Ghadirli, & Rastgarpour, 2013; Crockett, Latham, & Whitton, 2017), one of which is by the forward chaining method. The forward chaining method is an inference multiplication that connects a problem with a solution called the chain (Harjanto et al., 2018). Chains that are passed or crossed from a problem to obtain a solution are called forward chaining. The Forward Chaining method is one of the two main methods of reasoning (thought) when using an inference engine (decision maker) and can be logically described as a repetition application (a set of rules of inference and valid arguments). Based on the problems and information proposed a solution that can be used to determine the student learning style, an expert system application that has the ability to analyze the type of student learning style. The application of this expert system can help students find the best solution or learning method for the students. For teachers, the results of the detection of learning styles can also help in selecting the right methods or learning strategies. Thus, the process and learning outcomes of students can be more optimal.

Method

This expert system will solve a problem in the expert system which in this design is carried out using forward chaining techniques which are troubleshooting from the facts to a conclusion. That is, tracking starts from the state of the facts and then matches with the expected goal. The application of inference machines with the logic of IF-THEN rules with the forward chaining method is seen as follows.

Rule 1 : IF (G01 AND G02 AND G03 AND G04 AND G05 AND G06 AND G07 AND G08 AND G09) THEN H01

Rule 2 : IF (G01 AND G02 AND G03 AND G04 AND G10 AND G11 G12 AND G13 AND G14 AND G15) THEN H02

Rule 3 : IF (G16 AND G17 AND G18 AND G19 AND G20 AND G21 AND G22 AND G23 AND G24 AND G25 AND G26 AND G27) THEN H03

Rule 4 : IF (G16 AND G17 AND G18 AND G19 AND G20

AND G21 AND G28 AND G29 G30 AND G31 AND G32) THEN H04

Rule 5 : IF (G33 AND G34 AND G35 AND G36 AND G37 AND G38 AND G39 G40 AND G41 AND G42) THEN H05

Rule 6 : IF (G33 AND G34 AND G35 AND G36 AND G37

AND G38 AND G43 AND G44 AND G45 AND 46) THEN H06

Rule 7 : IF (G47 AND G48 AND G49 AND G50 AND G51 AND G52) THEN H07

Activity diagrams describe the process and sequence of activity in an expert system process. The activity diagram describes the event when the user accesses the home menu, as seen in the following image.

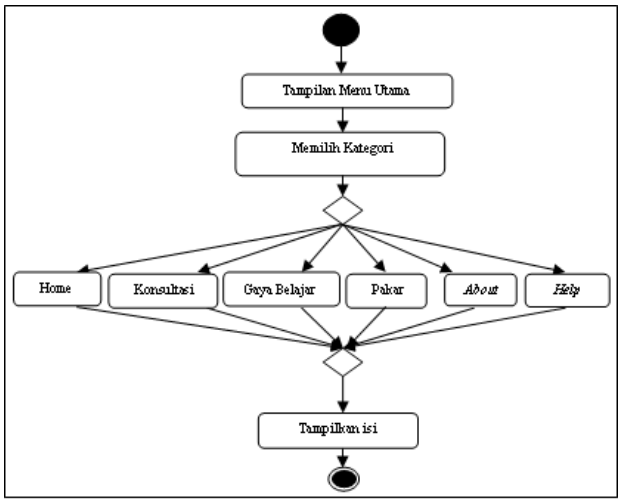

Figure 1. Activity Expert System Diagram

Decision Tree

To determine the flow of the question and decisions of the expert system, a decision tree or decision tree that contains the flow of questions about learning styles. The following is a decision tree for learning style in the expert system that will be designed.

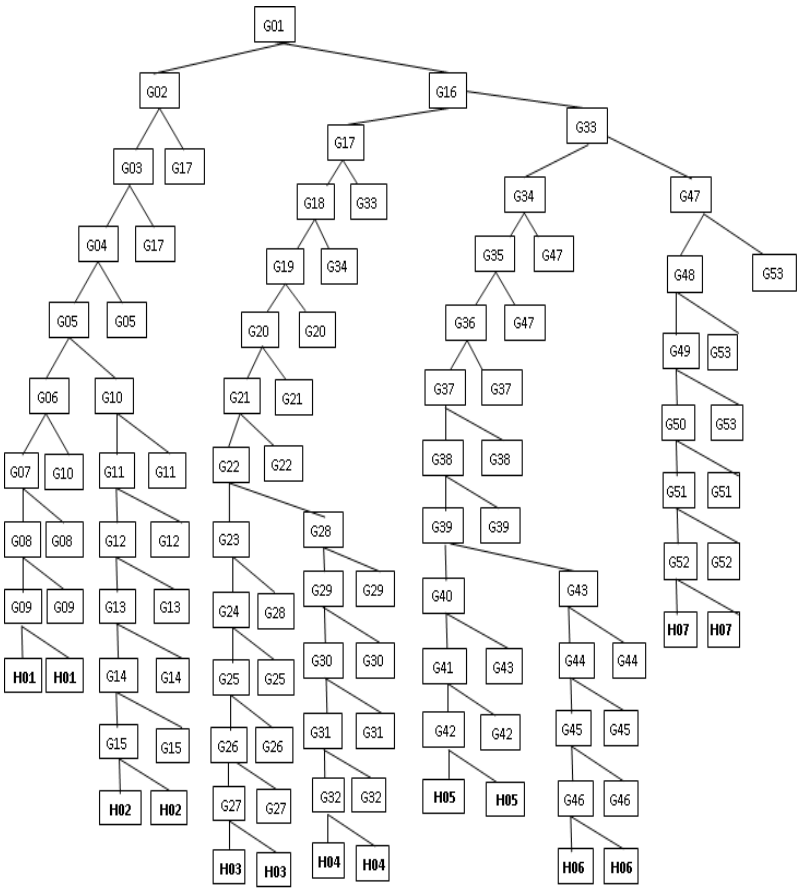

Figure 2. Decision Tree Expert System

Results and Discussion

Research related to the learning style has been done a lot before (Balasubramaniam, & Indhu, 2016; Stirling, & Alquraini, 2017; Alkooheji, & al-Hattami, 2018). Learning style for certain expertise and material, such as the ability to write (Untoro, 2016), the ability to draw (Rais, Aryani, & Ahmar, 2018), also affecting attitude learning (Weng et al., 2018), has an impact on Blended Learning (Shamsuddin , & Kaur, 2020), there is also a relationship between learning styles with teaching style (Toyama, & Yamazaki, 2020), the impact on the Working Group (Soetanto, & Macdonald, 2017), the combination of cooperative learning and learning styles of conceptual understanding (Kade, DeGeng, & Ali, 2019), and Student's Higher Order Thinking Skill Level (Zulfiani, SuWarna, & Sumantri, 2020). Furthermore, this learning style can also be identified through the algorithm and expert system (Bernard et al., 2017), through simulation (Çelik, Ceylantekin, & KiliIc, 2017), using Learning Analytics (Jena, 2018), through game games (Khamparia, & Pandey, 2018). However, learning styles also need to be evaluated (Ibrahim, & Hussein, 2016; O'mahony et al., 2016).

Engineering education in the learning process also certainly has the uniqueness of learning style (Larkin-Hein, & Budny, 2001). This learning style can be predicted with a specific application design through the Expert System (Movafegh Ghadirli, & Rastgarpour, 2013; Márquez et al., 2015; Ozdemir et al., 2016; Marlinda, Saputra, & Indrarti, 2019; Sakaan, & abdel-wahab, 2021), one of them is by the forward chaining method. The system discussion is the implementation of a process that translates the design results into the form of software in full (Ekayani, 2017). The implementation of the interface is to translate layouts that have been made on the interface design into the form of a system of intact interfaces (Sidharta and Wati, 2015). The implementation of the system interface is done to find out whether the system that has been designed can run correctly according to the design that has been previously designed.

Main Page

The main menu display is a menu that will appear when the program is executed after going through the boot process. The following is the result of the consultation menu display on this application.

Figure 3. Display the main menu

Consulting Menu

The consultation menu display will appear when the user selects Button consultation on the main menu. The consultation menu will ask questions to the user and provide the "yes" and "no" answer options. At the end of the consultation, the system will provide a diagnosis in the form of a type of learning force equipped with information on what Button, why, and how. But if the system does not find a user learning style, the system will bring a user to a complaint menu so that the user can share the problem with experts.

Figure 4. Display the Consultation Menu

Complaint Menu

Figure 5. Look Page Complaint

Main Information Menu

Figure 6. Display Information Menu

Expert Menu

The expert menu that functions as a system repair media. Among them, there are menus that create new accounts, style data, knowledge data, candidate data, expert data, and explanatory data.

Figure 7. Expert Menu Display

Conclusion

Conclusions that can be taken from the design of the expert system to determine the type of student learning style is the application of this expert system already able to diagnose the type of student learning style and find the best learning method for students. This application can be used by students as the main user and parents of students or teachers who want to know the student learning style. Teachers or experts who have knowledge of learning styles can be experts to make improvements to this system.

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