Artificial Intelligent in Education: The Development of '*Disabel*' System to Analyze Student Learning Styles

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Artificial Intelligent in Education: The Development of '*Disabel*' System to Analyze Student Learning Styles

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Abstract. The industrial revolution 4.0 is Characterized by automation and digitalization in various sectors. This of course has an immediate impact on the development of education. The Science of Technology has been integrated into the education sector so that the modern era of education can Utilize technological developments to improve the quality of education. The quality of education is related to the learning process. Learners must maximize the learning process to improve learning outcomes. Learning style plays an important role in the learning process, learners must therefore Recognize the learning style they have. This study aims to analyze learning styles based on the type of learning style classification (*visual, auditory and kinesthetic*). The research uses waterfall method and developed based on the website by applying the principle of artificial intelligence by applying the forward chaining algorithm as an inference engine. The forward chaining is designed based on the rules of the system knowledge and collaborated with knowledge of learning styles. To assess the system, the program was tested twice by involving two program experts. The results of the first learning style analysis system test program obtained an average score of 3.68 on a scale of 4 with the criteria of "Very Good". Second program expert assessed this system with an average score of 3.89on a scale of 4 with criteria for "Very Good". Then the overall score for the learning style analysis system at a score of 3.87 with the criteria of "Very Good".

Keywords: Learning style; Waterfall; Artificial intelligence.

1. Introduction

The 21st century has entered the era of industrial revolution 4.0 are characterized by the presence of various innovations in the form of automation and digitalization. Innovations are realized in order to facilitate human work and replace the role of man as an object. The industrial revolution has brought new technology trends in the data science and artificial intelligence that makes people have to be prepared to change in various sectors. This is a vision where the world wants to Realize a real environment connects to the digital one follows using driving forces: The Internet of things, cloud computing, big data, cyber-physical systems, and others [1]. This of course affects directly Cosmos developments in the field of science, especially science education. In this era of rapidly evolving technology education has positioned itself appropriately. Education adapts itself in line with the development of modern technology. That is certainly good news for the world of education to improve the quality of education of various lines [2],[3].

The important thing that must be considered to improve quality is the process of delivering information (learning material) [2],[4],[5]. Educators as facilitators of learning need to address this and ensure ongoing communication as well as educators have to know the characteristics of the students as recipients of the message. Communication is a process of removal and exchange of messages, where a message can take the form of facts, ideas, feelings, data or information from one person to another [6],[7],[8],[2]. Quality education is inseparable from the learning process is an important pillar to increases education quality [9],[2].

The development of technological science has been integrated into the science of education, making it possible in the modern education era to utilize technological developments to improve the quality of education. The presence technology innovation and developing trends in science education technology helps to develop educational model into a better direction. The presence of artificial intelligence helps people to solve complex problems that can only be solved by experts [10],[11],[12],[13]. Such innovations can be implemented to recognize learner's characteristics so that learners have to know the characteristics of learning styles can maximize the information transfer process.

This study aims to analyze learning styles based on the type of learning style classification (*visual, auditory and kinesthetic*). The research uses waterfall method and developed based on the website by applying the principle of artificial intelligence by applying the forward chaining algorithm as an inference engine.

The rest of this paper is organized as follow: Section 2 describes the notions of learning style, AI, expert systems, and interference engine. Section 3 presents the proposed research method. Section 4 presents the obtained results and following by discussion. Finally Section 5 concludes this work.

2. Rudimentary

This section describes the notions of learning style, AI, expert systems, and interference engine.

2.1. Learning Style

Learning style is defined as the efforts made to facilitate the learning process. A student or learner will use certain ways to help capture and understand a subject matter. Students should be able to notice how these learning styles so that students can more easily understand the subject matter and students can develop more optimal learning potential [3],[13]. Ehrman [14] explains that the ability to understand and absorb the lessons is certainly different levels. There are fast, moderate, and some are very slow. Humans are born with different environmental and social conditions. This, of course, affects the human characteristics including learning styles. Learning style will affect someone in absorbing and processing information. To determine the tendency of students to the learning styles that influence it, there is a variety of learning styles proposed by experts. DePorter [6],[7] differentiated learning styles into three types, namely; (1) visual type; (2) the type of auditory; (3) the type of kinesthetic. It is based on how people absorb information and process and present it.

2.1.1. Visual Type

Type of visual learning is learning through seeing, watching, observing, and the like. People with this type prefers studying or receiving information by seeing or reading. After viewing or reading, they will be easier and faster to digest and process new information is received [15]. This visual learning strength lies in the sense of sight. For people with this learning style, the eye is the most sensitive tool for capturing any symptoms or learning stimulus. Moreover, people with a visual learning style tend to like to follow instructions, observing the images, and review the events directly [4],[5]. Students who have a visual learning style is a high demand to see and capture the information visually before he understood it. Students who have a visual learning style captures the lessons through pictorial materials and other media relating to the senses of vision.

2.1.2. Auditory Type

People with this learning style, more dominant in using the sense of hearing to conduct learning activities. In other words, it is easy to learn, easy to catch the stimulus or stimuli when by means of the sense of hearing. People with auditory learning style has the power on his ability to hear [6][7][9][5]. Some characteristics of an auditory among others can remember the information in a way to hear or listen, preferring to learn by discussing, prefer to speak or tell stories, usually not a good reader and frequent difficulties in tasks writing composing [5].

2.1.3. Type Kinesthetic

Kinesthetic learning styles are learning styles by moving, working, and touching. The point is to learn by prioritizing the sense of taste and physical movements. People with this learning style find it easier to learn when he moves, feels, or takes action [6][7][9][5]. Kinesthetic learning styles are learning activities by moving, working and touching. This type of learner is unique in learning which is always moving, sensory activity and touching. These learners find it difficult to sit still for hours because their desire for activity and exploration is very strong.

2.2. Artificial Intelligence

For thousands of years, we have tried to understand what one's way of thinking, that is how a concept to be able to see, understand, predict, and manipulate the world bigger and more complicated than itself. Field of artificial intelligent (AI) was much farther away, the AI is not only trying to understand but to make an intelligent entity [12],[13]. Artificial Intelligent sometimes also referred to as machine intelligence or heuristic programming, is the emerging technology that attracts publicity. One of the things that are visible from this field is that AI emphasizes how to make computer programs smarter [12].

2.3. Expert system

In computer science, a lot of experts who concentrate on the development of Artificial Intelligence. Artificial Intelligence is a special study in which their end is to make computers think and act like humans [11],[13]. An expert system is a computer program that shows the degree of expertise in solving problems in a particular field is comparable to an expert (see Figure 1). Another opinion states that the expert system is a program that automatically makes suggestions that try to mimic the process of thinking and knowledge of experts to achieve the objectives of the specific problem [11],[16],[13].

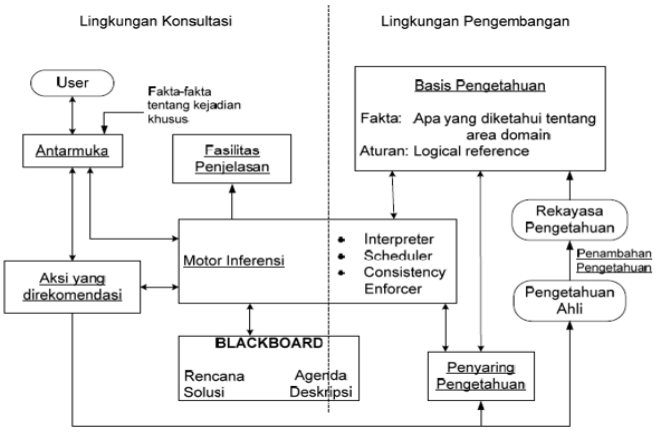

Figure 1. Design of structures and components on expert system

An expert system consists of two main parts, namely: environmental consulting and environmental development. The development environment is used as an expert system builders in terms of both the builders and the components of the knowledge base. Environmental consulting is used by someone who is not an expert to consult. Expert system split the two parts into seven principal components that make up an expert system. The components contained in the expert system are as follows; (1) Subsystem

expansion of knowledge. (2) The knowledge base. (3) Motor inference. (4) Blackboard. (5) Interface. (6) Subsystem explanation. (7) filter system knowledge [11].

2.4. Interference Engine

An inference engine is used to control the inference in a rule-based expert system [12]. The program was developed in the underlying analysis by inference tracking the fore. Tracking the future is driven approach to data that is data-driven. In this approach, the tracking starts from the input information, and then try to illustrate conclusions. Tracking forward looking facts in accordance with section IF of IF-THEN rules.

3. Method

The method used in system development is the waterfall method. The waterfall is a classic model that proposes an approach to systematic and sequential software development that starts at the level of system progress throughout the analysis, design, code, and testing [13]. The following is the stage of the waterfall model (see Figure 2). This method is a method that is often used by system analyzers in general. The essence of this method is the workmanship of a system is carried out linearly.

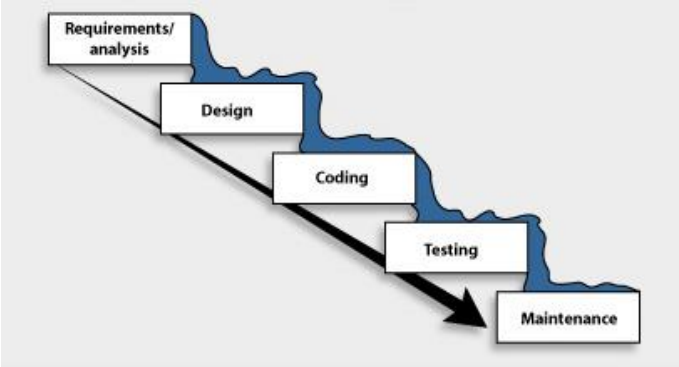

Figure 2. Waterfall's method.

A system will run well if it has the basic concept that can accommodate and transform data so it can be processed into information data. An artificial intelligence system contains at least two essential compo-nents, namely the inference engine and knowledge base (see Figure 3).

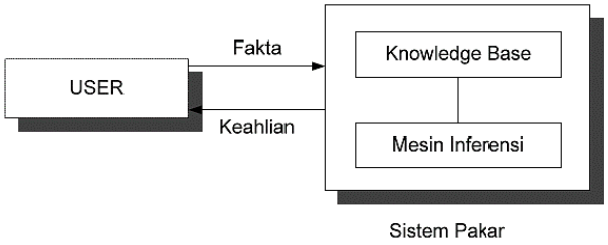

Figure 3. The basic concept of artificial intelligence

The knowledge base contains very specific knowledge provided by an expert to solve a particular problem [10],[12]. Knowledge of an expert system may be an expert or the knowledge that is generally found in books, magazines, and people who have knowledge of a field. A part in an expert system consists of two main components, namely the knowledge base that contains knowledge and inference engine that draws conclusions. The conclusion of the expert system is a response to user requests.

Tracking methods used in building the learning style analysis expert system is to apply the principle of forward Chaining. This method works by keeping track of all the data and rules that will be searched to get the final information in the form of the analysis results. A rule is based on knowledge is divided into two main parts, namely the facts and conclusion. The next part of the fact regrouped into facts that are more specific to each group then the facts would establish a rule that has a certain conclusion. In this case, it will be explained how the flow of the process when using a forward chaining method that can be seen in the following Figure 4:

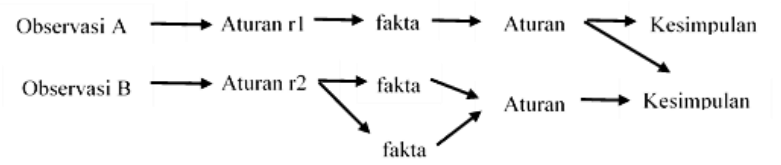

Figure 4. Process data path forward chaining inference engine

Likert scale is used to measure attitudes, opinions, and perceptions of a person or group about social events or symptoms [17]. In this case, the Likert scale is used to test the system being developed. The Likert scale table for assessment of questionnaire instruments is given in Table 1 as follows.

Table 1. Likert scales

Value scale	Interpretation
4	Very feasible
3	Feasible
2	Less feasible
1	Not feasible

Next, calculate the score of the assessment criteria produced by determining the interval based on the highest (ideal) and lowest (ideal) scales. The criteria are attached in the following Table 2.

Table 2. Classification of Average Scores

Average score	Category
$3.25 \leq xi \leq 4.00$	Very feasible
$2.50 \leq xi \leq 3.24$	Feasible
$1.75 \leq xi \leq 2.49$	Less fesible
$1 \leq xi \leq 1.74$	Not feasible

4. Result and Discussion

This section presents the obtained results and following by discussion.

4.1. Requirements

This program was developed based on the website using the PHP programming language. To develop the PHP programming language, Dreamwaver and MySQL applications are used as database programming languages. Artificial intelligence uses the principle of an expert system by applying the forward chaining method as an interference machine. This program interface will use dominant colors in green and white. This program will analyze types of learning styles (*visual, auditory and kinesthetic*).

4.2. design

Modeling a system there requirements. System requirements that must be met, such a system can be modeled must have a unit where a clear functional relationship between the input and output process. Or can we describe that the system should be modeled a scenario where this modeling system can be

done from a user perspective, the system can be defined in the data objects to be transformed by the function of the process is usually modeled in the flowchart as depicted in Figure 5.

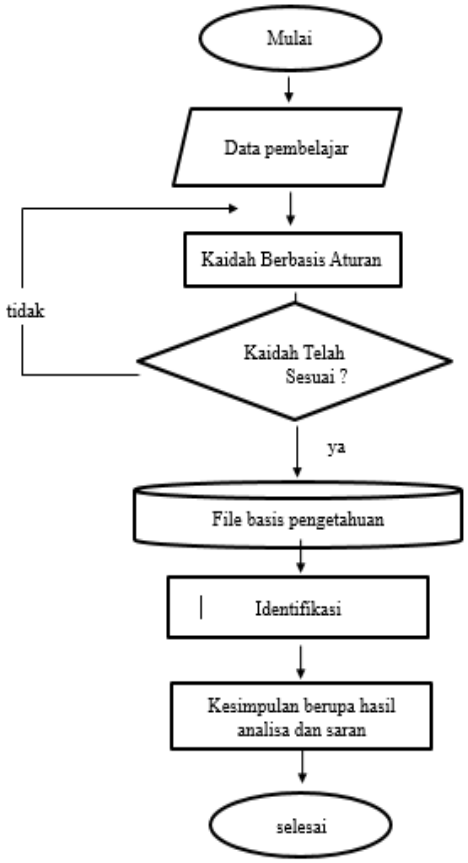

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Figure 5. Flowchart on the principle of forward chaining.

From the flowchart above, may explain the steps forward that reasoning inference process is done by entering data in the form of the fact that the input by the user. Then the data is compiled into the rule-based rule, after which it happened to check that the rules are appropriate or not. If not, then the user will return to fill other facts, but if the rule is appropriate then, the rules or the facts stored in file-based knowledge in the form of a database which is then processed until the user can perform the identification process. Of identification, you will see the characteristic features of data included learning styles produce a conclusion in the form of analysis of types of learning styles. This program has 4 main menus, namely; (1) home, (2) *layanan kami*, (3) *gaya belajar*, (4) *konsultasi*, (5) *tentang kami*, (6) *tentang program* (See Figures 6, 7 and 8).

4.3. coding

To analyze the learning style, first need to identify in advance the characteristic features of learning style that experienced by the user (learner). the characteristics of these learning styles will be processed by experts and then classified based on the type of learning style seems. In the design of this system is classified into 3 types of learning styles namely; (1) visual type, (2) the type of auditory and (3) the type of kinesthetic. To be more easily understood by the program, the types of learning styles are made in the form of code such as the Table 3 below;

Table 3. The classification of types of learning styles

Type of learning styles	code
visual	P001
auditory	P002
kinesthetic	P003

The learning Style knowledge base will classify each student's learning style Adopted from the Center for Advanced Research on Language Acquisition University of Minnesota (see Table 4) [18].

Table 4. The classification of the characteristic features of learning styles

The characteristic features of learning styles	Code
Easily I remember the jokes that I hear	G001
I use color-coding to help me as I learn or work	G002
I think better when I move around (eg, pacing or tapping my feet)	G003
Background sound helps me think	G004
I draw lots of pictures (doodles) in my notebook during lectures	G005
I remember things better if I discuss them with someone.	G006
Manipulating objects helps me to remember what someone says	G007
I play with or bite on my pens during lectures	G008
I can understand what people say even when I can not see them	G009
I remember peoples' names but not their faces.	G010
I can identify people by Reviews their voices (eg, on the phone)	G011
I need to eat something when I read or study	G012
I prefer to start doing things rather than checking the Reviews directions first.	G013
I need oral Reviews directions for a task	G014
I prefer to learn by listening to a lecture rather than reading	G015
I remember peoples' faces but not their names.	G016
I remember something better if I write it down.	G017
I need written Reviews directions for tasks.	G018
If I have a choice between sitting and standing, I'd rather stand.	G019
I understand lectures better when professors write on the board	G020
I can identify people by Reviews their voices (eg, on the phone)	G021
I have to look at people to understand what they say.	G022
I take detailed notes during lectures.	G023
I move my hands when I speak	G024
I need frequent breaks when I work or study.	G025
When I listen, I visualize pictures, numbers, or words in my head.	G026
Charts, diagrams, and maps help me understand what someone says	G027
When I turn on the TV, I listen to the sound more than I watch the screen	G028
I get nervous when I sit still too long	G029
I like to listen to music when I study or work	G030

After the coding stage is given for each type and characteristic of learning styles, the system will easily recognize and identify it. The code is then included in a relationship-based rule that shows the relationship between the types of defense styles to the characteristics of learning styles.

Table 5. relationships are the features of learning styles on the type of learning style

Code of learning styles	relation

P001	G002, G016, G017, G018, G020, G022, G023, G026, G027,
P002	G001, G004, G006, G009, G010, G011, G014, G015, G021, G028, G030
P003	G003, G005, G007, G008, G013, G019, G024, G025, G029

The data from the relation Table 5 above shows the relationship between types of learning styles and characteristics of learning styles. in the visual type learning style shown by the code (P001) it seems to have a relationship with the characteristics of the learning style shown by the code (G002, G016, G017, G018, G020, G022, G023, G026, G027). In order for the code to be processed into meaningful information, it must be given a rule-based programming algorithm by using the principle recognized by the forward chaining inference engine. Forward chaining begins by displaying data sets or facts until the final conclusion is reached. forward chaining works starting from fact information (IF) first then going to derived information (then) or can be modeled like the following rule (see Table 6).

Table 6. The relationships are the features of learning styles on the type of learning style

Rule 1 Visual learning style	Rules 2 Auditory learning style	Rules 3 Kinesthetic learning style
IF G002 AND G016 AND G017, AND G018, AND G020, AND G022, AND G023, AND G026, AND G027. THEN visual (P001)	IF G001 AND G004 AND G006, AND G009, AND G010, AND G011, AND G014, AND G015, AND G021. AND G028, AND G030. THEN auditory (P002)	IF G003 AND G005 AND G007, AND G008, AND G013, AND G019, AND G024, AND G025, AND G029. THEN kinesthetic (P003)

4.4. System Testing

this system is named *diagnosa gaya belajar* (*disabel*), to access this program can go to the *bit.ly/disabel* page with your browser. After you have successfully entered the system, you will enter the main menu of the program. In the main menu a brief description of the program is explained. To start the consultation you can go to the consultation menu, if you have not registered on the system you must first register. After that you can start the consultation by answering 30 statements. You must answer the statement with a statement [*benar* / *salah*]. At the end of the program, the system will display the results of your learning style analysis by showing the level of probability of your learning style. Not only that, the program also displays suggestions for certain types of learning classifications.

Figure 6. Homepage

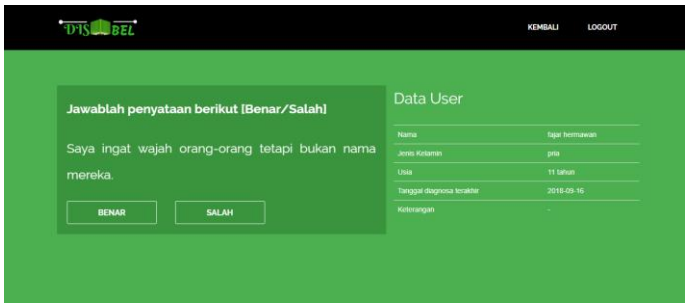

Figure 7. Learning style consultation process

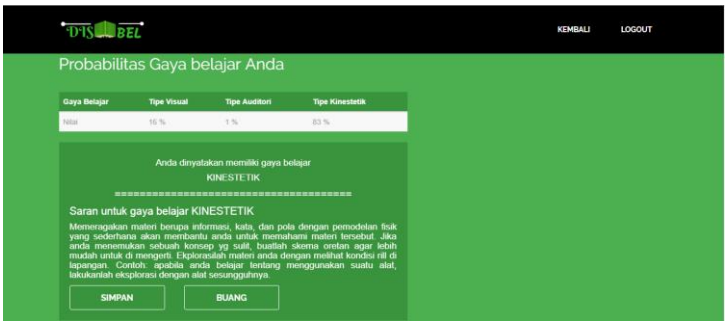

Figure 8. Learning style analysis results

To assess the system, the program was tested twice by involving two program experts. The results of the first learning style analysis system test program obtained an average score of 3.68 on a scale of 4 with the criteria of "Very feasible". The second program expert assessed this system with an average score of 3.89 on a scale of 4 with criteria for "Very feasible". Then the overall score for the learning style analysis system at a score of 3.87 with the criteria of "Very feasible". The following are the results of multimedia learning by media experts presented in the bar diagram (see Figure 9).

Figure 9. Result of program testing by expert

4.5. Maintenance

This is the last stage in system development. The finished system is run and maintenance is carried out. Maintenance is included in correcting errors that were not found in the previous step.

5. Conclusion

Learning styles are things that need to be more attention. Making an analysis of learning styles will certainly make it easier for the learner to know the characteristics of the learning style he possesses. a system that can analyze learning styles can be built by applying the principle of artificial intelligence that is collaborated with the principle of forward chaining as rule-based inference. based on the results of testing by experts, this program can be used to analyze learning styles very feasible.

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