Machine Learning For Identification of Learning Modalities

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ABSTRACT
Learning modality is a way of absorbing information through our senses. Learning modalities are important to identify because the potential for successful learning in academics is one of them supported by the right learning modalities. The appropriate learning modality will support a person's success in learning and achieving good achievements. Machine Learning is a subset of Artificial Intelligence (AI) that can understand the structure of data and put that data into models that people can understand and benefit from. This study aims to identify a person's learning modality by implementing Machine Learning techniques using the Forward Chaining method. Forward Chaining is a method of concluding based on existing data or facts that lead to conclusions. Forward Chaining searches from a problem to a solution. The parameters used in this study are communication, learning, preferences, memory, and attitudes. The results of the identification of modalities are categorized into seven types, namely visual, auditory, kinesthetic, visual-auditory, auditory-kinesthetic, visual-kinesthetic and visual-auditory-kinesthetic.

Keywords: *machine learning, forward chaining, learning, modality*

1. INTRODUCTION

Learning modality is a person's way of absorbing information through their senses [1]. In general, a person uses three sensory preferences, namely based on visual (vision), auditory (hearing), and kinesthetic (touch and movement), which is known as the V-A-K modality [2]. At the beginning of the learning experience, the first step is to identify a person's modalities, whether they are visual, auditory, or kinesthetic (V-A-K) modalities. Learning modalities are very necessary for learning because with this modality a person can absorb, then organize and process the information obtained from learning.

According to Deporter [3], there are three types (modalities) in learning, namely Visual, Auditory and Kinesthetic. Visual learners learn through what they see, auditory learners learn through what they hear, and kinesthetic learners learn through physical movement and touch. Although in reality, each person learns by using these three modalities, at a certain stage most people are more inclined to one of the three modalities that dominate. One needs to recognize the learning modality because it will greatly affect the selection of the learning method used. The selection of the right learning method is an important factor in achieving learning objectives. The use of learning modalities can increase one's concentration in learning to increase motivation for achievement which will then affect increasing learning outcomes.

Several related research focus on the identification of learning modalities. Prasetyo et. al [4] researched the selection of learning styles using the Decision Tree method. Soewono et. al [5] developed an expert system to identify student learning modalities by implementing the C4.5 algorithm. Ramadandi and Jahring [6] conducted a study on the classification of student learning styles using the Naïve Bayes Classifier method. Rohani [7] in her final assignment research developed an expert system to determine the modalities or learning styles of children. Anwar [8] designed an expert system to determine student learning styles by using Forward Chaining in engineering education. Hardiansyah et. al [9] developed an expert system for identifying student learning modalities using the Forward Chaining and Certainty Factor methods.

In contrast to previous studies, in this study, the identification process of a person's learning modality is carried out by applying machine learning using the Forward Chaining method with five measurement parameters, namely communication, learning, preferences, memory, and attitudes. Machine learning is a type of Artificial Intelligence (AI) that develops computers with the ability to learn without being explicitly programmed. Machine learning focuses on developing computer programs that can teach themselves to evolve following new data [10]. Meanwhile, the Forward Chaining method is a logical if-then-based method. Forward Chaining is a method that has a search strategy that starts the search process from a set of data or facts, and from these data a conclusion is sought [11].

2. METHODS

This research was conducted in several stages, namely identification of problem, literature review, data collection, needs analysis, process modeling, and testing.

a. Identification of Problems
   From the identification process, it was found that the problem was how to determine a person's learning modality.
b. Literature Review
   The literature study was carried out by searching for literature related to research, namely literature on the implementation of machine learning and forward chaining, and literature on the object of research, namely learning modalities.
c. Data Collection
   Data collection is done through business process documents and interviews with related parties. The business process document is in the form of a questionnaire.
d. Needs Analysis
   Needs analysis aims to determine the data to be used. From the analysis process carried out, it is known that the data used are interview/questionnaire data, rule data, and modality characteristic data.
e. Process Modeling
   The business process modeling for the application of machine learning is made using a flowchart as shown in Figure 1.
f. Testing
   The test carried out is the calculation of the percentage level of accuracy to select the identification results that are considered the most appropriate. The level of accuracy is calculated using the formula :

$$accuracy = \frac{\sum mr}{\sum dr} x\ 100\% \quad (1)$$

Where:
∑ mr (match rule) : number of fulfilled rules
∑ dr (defined rule) : number of specified rules

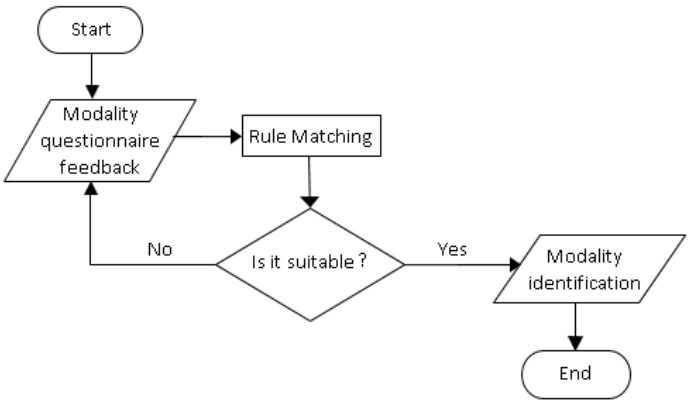

Figure 1. Process modeling of machine learning for identification of learning modalities

3. RESULTS AND DISCUSSION

In this study, the identification process of learning modalities was carried out using five measurement parameters, namely communication, learning, preferences, memory and attitudes. The measurement parameters are presented in Table 1.

Table 1. Measurement parameters

Code	Parameter	Value
c	Communication	V, A, K
l	Learning	V, A, K
p	Preference	V, A, K
m	Memory	V, A, K
a	Attitude	V, A, K

The data set that is used as a comparison against a person's measurement results is defined in the Value field. The determination of the rules and modalities used in this study was obtained from experts and some related literature. The list of modalities and rules used is presented in Table 2 and Table 3.

Table 2. Learning modalities

Code	Modality
M-01	V
M-02	A
M-03	K
M-04	V-A
M-05	A-K
M-06	V-K
M-07	V-A-K

Table 3. Identification rules

Code	Rule
RULE-01	if $c_v+l_v+p_k+m_v+a_v$ then M_1
RULE-02	if $c_v+l_v+p_v+m_v+a_v$ then M_1
RULE-03	if $c_k+l_v+p_v+m_v+a_v$ then M_1
RULE-04	if $c_v+l_a+p_a+m_a+a_a$ then M_2
RULE-05	if $c_k+l_a+p_a+m_a+a_a$ then M_2

RULE-06	if c_a+l_a+p_a+m_a+a_a then M_2
RULE-07	if c_k+l_k+p_a+m_a+a_k then M_5
RULE-08	if c_a+l_a+p_v+m_a+a_v then M_4
RULE-09	if c_k+l_v+p_k+m_v+a_v then M_6

To get the identification results, based on the flow in the modeling process shown in Figure 1, the test result data (facts) as training data are compared with the previously defined rules by looking at the data set. If the facts meet the conditions of the IF requirements, the rule is executed and will produce a new fact (the THEN section) in the form of identification results that contain details of a person's learning modality. The test to find the percentage of accuracy in the process of identifying learning modalities is calculated using equation (1). The data for the measurement of the modality parameters carried out are presented in Table 4. This data was obtained from the results of filling out a questionnaire form to determine the condition of a person's characteristics seen from the five parameters measured, namely communication, learning, preferences, memory, and attitudes.

Table 4. Data for testing learning modalities

Person	Parameter					Modality Identification
	Communication	Learning	Preference	Memory	Attitude	
1	V	V	K	V	V	V
2	V	V	V	V	V	V
3	K	V	K	V	V	V-K
4	V	A	A	A	A	A
5	K	K	A	V-A-K	A	A
6	K	K	A	A	K	A-K

From Table 4, it can be seen that for the conditions of the data being tested, the test scenario for 6 respondents met the conditions of 5 rules, namely RULE-01, RULE-02, RULE-04, RULE-07 and RULE-09. By using the percentage accuracy formula in equation (1), for the data from the identification of learning modalities in this study, an accuracy of 83.3% was obtained from the calculation:

$$accuracy = \frac{5}{6} x\ 100\% = 83.3\%$$

4. CONCLUSION

Based on the design and testing in this study, it can be concluded that the processing of parameter measurement data can lead to several rules in obtaining identification results. Parameter measurement data will be compared with default data (data set). Getting a sufficiently high percentage of accuracy means that the resulting identification is close to the predefined rules.

This research still has limitations that can be used as a basis for further research development, including the development of a learning modality identification process using methods or algorithms other than forward chaining and adding a more complex knowledge base.

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