Identification Types Of Student Learning Modalities In Physics Subjects With Expert Systems Using Bayes Theorem Method

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ABSTRACT

Learning modality is a person's way of absorbing and processing information effectively and efficiently. This study aims to determine the results of the identification types of student learning modalities in physics subjects with an expert system using the Bayes theorem method, and the accuracy of the Bayes theorem method in identifying types of student learning modalities in physics subjects. This study uses the Bayes theorem method because it can produce a parameter estimate by combining information from the sample and other information that has been previously available to determine the results of the learning modality. This study uses 21 characteristics of learning modalities, 3 types of learning modalities, and 30 test cases obtained from an expert physics teacher at SMA Sumsel Jaya Palembang. Based on the tests that have been carried out, the results show that the system has an accuracy of 90% in identifying types of student learning modalities in physics subjects. It can be concluded that the Bayes theorem method can be used to identify types of student learning modalities in physics subjects.

1. Introduction

Learning modalities are the key to developing student success in learning at school. Learning modality is a combination of absorbing, organizing and processing information[1]. The way of learning will make the person to always interact with the environment that can create individual behavior, so humans are called social beings [2]. Learning modalities can affect classroom learning, one of which is physics. Physics is part of the Natural Sciences that studies nature systematically according to discoveries, facts, concepts or principles and progress in the application of knowledge in everyday life [3].

In physics subjects, not all students know their own learning modalities so they still find it difficult to understand physics lessons in class [4]. Some students still consider physics to be a difficult subject, due to the lack of interest of students in physics subjects [5]. Students learning modalities in physics lessons can be determined by an expert physics teacher with the help of a system. A system that can assisting students in identifying their type of physics learning modality is an expert system.

An expert system is a system designed to imitate the expertise of an expert in answering questions and solving a problem [6]. Expert systems can help solve problems that can only be solved and done with the help of experts in certain fields. This expert system can use Bayes' theorem, which is a method that can produce an estimate of parameters by combining information from samples and other information that has been previously available [7]. With the expert system, it is hoped that students will be able to know their own modalities of learning physics.

2. Literature Study / Hypotheses Development

a. Learning Modalities

Learning modality is a person's way of absorbing information, interacting, and communicating through their senses [1]. Learning modalities can be classified into three types, namely visual learning modalities, auditory learning modalities, and kinesthetic learning modalities [8]. Learning modalities have special characteristics, so that they have a strong influence on the success of the student learning process and can be used as considerations in determining strategies in learning.

b. Expert System

Expert system is a computer program whose way of working imitates the expertise of an expert in a skill and has a display that can be used by ordinary users so that it can help users make decisions [9]. An expert system is a computer program that simulates the judgment and behavior of a person or organization that has expert knowledge and experience in a particular field [10]. When designing a good expert system, the system designed must be able to solve various problems by imitating the workings and thoughts of an expert or experts. Expert systems allow students to solve problems that can be solved and worked on with the help of experts on certain skills.

c. Bayes Theorem

Bayes' theorem was discovered by an English Presbyterian priest named Thomas Bayes in 1763, then refined by Laplace, with the aim of calculating probabilities based on the effects obtained from observing an event. Bayes theorem is a method that can produce a parameter estimate by combining information from samples and other information that has been previously available [7].

This theorem explains the relationship between the probability of the occurrence of event A on the condition that event B has occurred and the probability of the occurrence of event B on the condition that event A has occurred. This theorem is based on the principle that additional information can improve probabilities [11]. In probability theory and statistics, Bayes' theorem is a theorem that states how far the degree of subjective belief must change rationally when there are new clues.

Bayesian probability is one way to improve data uncertainty by using the bayes formula [12]. The formula used is the Bayes formula (1) and (2).

$$P(H_i|E) = \frac{P(E|H_i) * P(H_i)}{\sum_{k=1}^{n} P(E|H_k) * P(H_k)} \quad (1)$$

$$\sum \text{Bayes} = P(E|H_i) * P(H_i|E_i) + \ ... + P(E|H_n) * P(H_n|E_n) \quad (2)$$

Explanation :
E = Data with unknown class
H_i = Hypothesis data E is a specific class
$P(H_i \mid E)$ = Hypothesis probability H_i based on condition E
$P(H_i)$ = Hypothesis probability H_i
$P(E \mid H_i)$ = E probability based on the hypothesis condition H_i
$\sum_{k=1}^{n} P(E \mid H_k)$ = Result of sum of probability E based on hypothesis condition H_k
∑ Bayes = The result of the number of probabilities E based on the hypothetical condition Hi multiplied by the hypothetical probability Hi based on the condition E

3. Methodology

a. Data

The data used in this study is the type of learning modality data, the characteristics of the learning modality and the probability value. The data was obtained from an interview with an expert physics teacher at the South Sumatra Jaya Palembang High School. The data can be seen in table 1:

Table 1. Table Data

Type of learning modality	Code	Characteristics of learning modalities	Probability
Visual	C01	Do an experiment	0.8
	C02	Remember faster	0.4
	C03	Have a strong memory regarding symbols	0.3
	C04	Have drawing skills	0.5
	C05	Write in detail	0.6
	C06	Have a hobby of reading	0.5
	C07	Have a careful observation	0.6
Auditory	C08	Remember well from what was heard	0.5
	C09	Likes to tell stories	0.6
	C10	Repeat information in detail	0.4
	C11	Likes to work on group assignments	0.7
	C12	Enjoy learning by discussion	0.8
	C13	Talk to yourself during activities	0.3
	C14	Rely on listening	0.3
Kinesthetic	C15	Various ways of learning	0.6
	C16	Likes to learn by practicing directly	0.8
	C17	Easier to memorize something by making movements	0.5
	C18	More physical activities	0.3
	C19	Can't sit still for a long time	0.3
	C20	Talk slowly	0.4
	C21	Pointing with finger while reading	0.4

b. Research Stages

The research will be carried out in several stages which can be seen in Fig. 1.

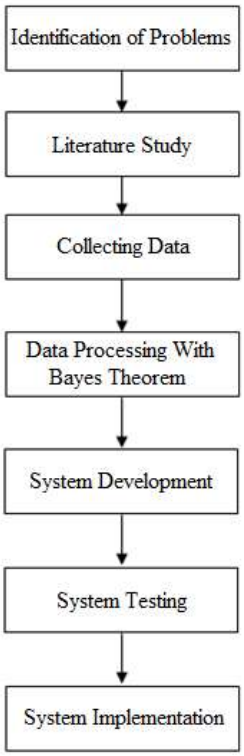

Fig. 1. Research Framework

The explanation of Fig 1 is as follows:

1. Identification of Problems
Identification of the problem in this study is how to identify the type of student learning modality in physics subjects with an expert system using the Bayes theorem method in order to obtain a solution for students and teachers.

2. Literature Study
Studying research by reading and understanding literature, journals, internet browsing and readings that are related to student learning modalities, either in the form of textbooks or papers.

3. Collecting Data
Collecting data is carried out for testing the Bayes Theorem method. Collecting data and dividing the data into predetermined characteristics along with their probability values.

4. Data Processing with Bayes Theorem
Data processing is carried out to adjust the data to be processed on the Bayes Theorem method which consists of several stages.

5. System Development
At this stage, carry out designing activities to create this research system. Next the system will be built according to the previous design that has been made.

6. System Testing
The testing method used in this research is black box testing. Black box testing is a test by observing the execution results of the test data and checking the functionality of the software by running the program according to the process.

7. System Implementation

The system will be implemented for high school students so that it can assist students and teachers in identifying the type of student learning modality for physics lessons.

4. Result and Discussion

a. Implementation

This expert system will implement bayes theorem to determine the type of student learning modality in physics subjects. The following display is the result of the system implementation:

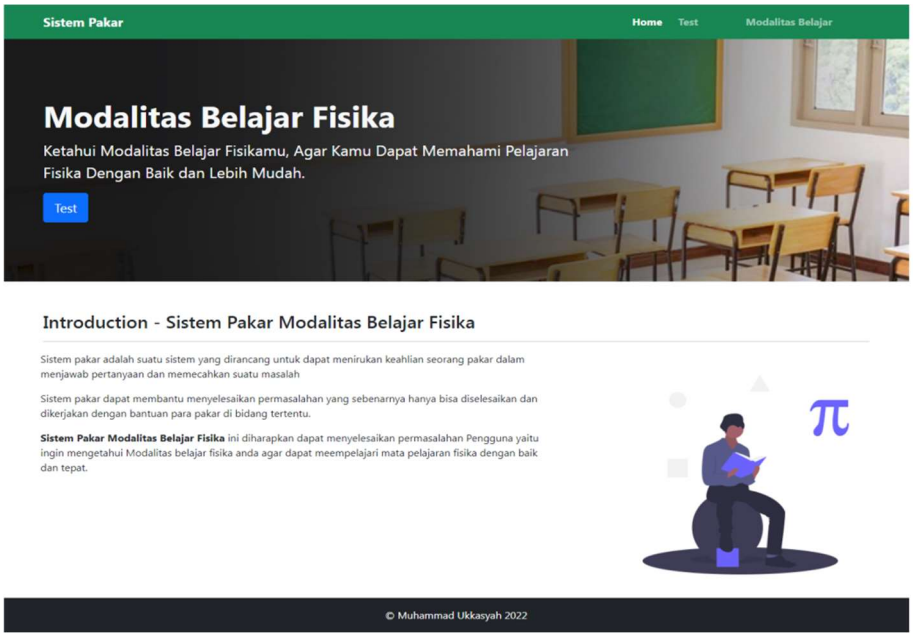

Fig. 2. Home Page Interface

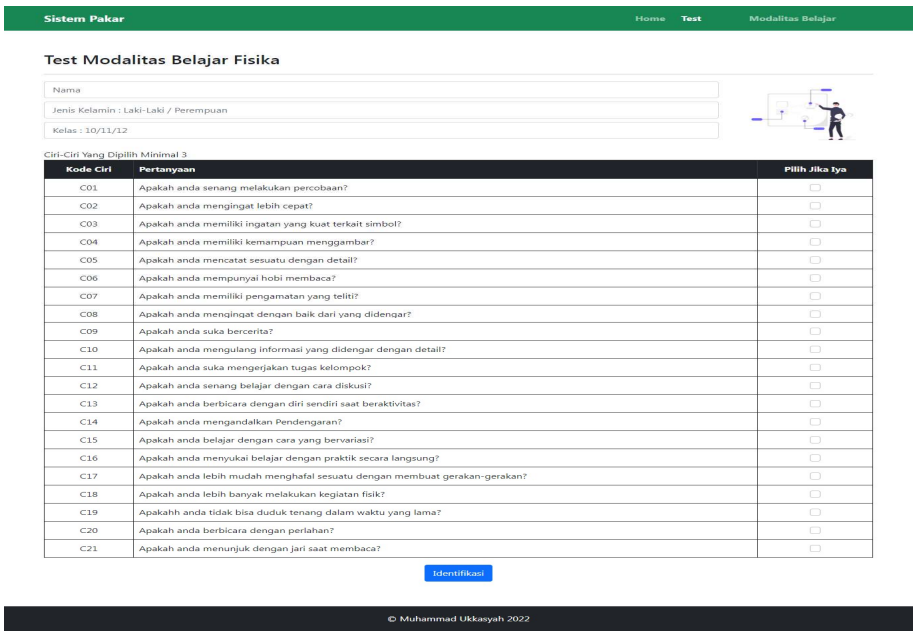

Fig. 3. Test Page Interface

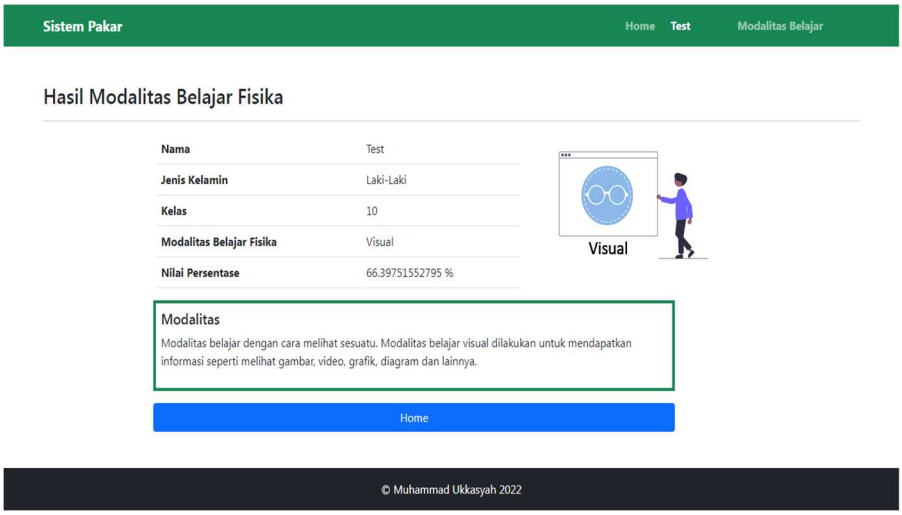

Fig. 4. Result Page Interface

b. Research Analysis

Testing the expert system software for the type of student learning modality in physics subjects using case data as much as 30 data obtained from physics teachers at SMA Sumsel Jaya Palembang. The input data for testing this expert system software are name, gender, class, and the characteristics of the user's learning modality. The output of the test is the result of identification in the form of the type of learning modality.

Table 2. Analysis of System Accuracy Test Results

Test Results		
Total Test Data	**Amount of "Appropriate" Data**	**Percentage Acuracy**
30 Data	27 Data	90%

From these tests, the results of the comparison between the diagnosis of expert and expert systems are obtained. Of the 30 test case data, there are 27 data that are the same between expert system diagnoses and expert diagnoses, there are also 3 data that are not appropriate. The misdiagnosis occurs because the percentage of outcome values between the types of learning modalities have the same results so that the expert system is difficult to determine the type of student learning modality. Based on the accuracy calculation, the software gets an accuracy percentage value of 90%.

5. Conclusion

Based on the research that has been done on the identification types of student learning modalities in physics subjects with expert systems using bayes theorem method, the conclusions obtained are the bayes theorem method used to identify the type of student learning modality in physics subjects has an accuracy value of 90%. With an accuracy value of 90%, it can be concluded that the identification carried out by the expert system is good and quite accurate.

The further development of this software is that it can be developed using other characteristic and other expert system methods to produce a better expert system.

References

[1] Soewono, R., Gernowo, R., & Sasongko, P. S., "Sistem Pakar Identifikasi Modalitas Belajar Siswa Dengan Implementasi Algoritma C4.5". Jurnal Sistem Informasi Bisnis, 4(1), 20–27, 2014.

[2] Marfuah, Z., "Hubungan Gaya Belajar Visual, Auditorial dan Kinestik dengan Hasil Belajar Matematika. Journal of Chemical Information and Modeling", 2016.

[3] Priandono, F. E., Astutik, S., & Wahyuni, S., "Pengembangan Media Audio-Visual Berbasis Kontekstual Dalam Pembelajaran Fisika Di Sma". Jurnal Pembelajaran Fisika, 1(3), 247–253, 2012.

[4] Supardi, S. U. S., Leonard, L., Suhendri, H., & Rismurdiyati, R., "Pengaruh Media Pembelajaran dan Minat Belajar Terhadap Hasil Belajar Fisika. Formatif: Jurnal Ilmiah Pendidikan MIPA", 2(1), 71–81, 2015.

[5] Erviani, F. R., Sutarto, & Indrawati., "Model Pembelajaran Instruction, Doing, Dan Evaluating (Mpide) Disertai Resume Dan Video Fenomena Alam Dalam Pembelajaran Fisika Di Sma". Jurnal Pembelajaran Fisika, 53–59, 2017.

[6] Ibrohim, M., & Purwanty, N., "Rancang Bangun Aplikasi Identifikasi Gaya Belajar Siswa Dengan Metode Forward Chaining (Studi Kasus : Sekolah Dasar Negeri Sumampir)". Jurnal ProTekInfo, 4(1), 19–28, 2017.

[7] Fadhillah, M. R., Ishak, I., & Ramadhan, P. S., "Implementasi Sistem Pakar Mendiagnosa Penyakit Penyakit Gastritis Dengan Menggunakan Metode Teorema Bayes". J-SISKO TECH (Jurnal Teknologi Sistem Informasi Dan Sistem Komputer TGD), 4(1), 1, 2021.

[8] Darmadi., "Pengembangam Model dan Metode Pembelajaran dalam Dinamika Belajar Siswa", 2017.

[9] Andriani, A., "Pemrograman sistem pakar : konsep dasar dan aplikasinya menggunakan visual basic 6". MediaKom, 2017.

[10] Arisandi, D., & Sari, I. P., "Sistem Pakar Dengan Fuzzy Expert System", 2021.

[11] Huda, M., "Algoritma Data Mining", Bisakimia, 2021.

[12] Syahputra, T., Dahria, M., & Putri, P. D., "Sistem Pakar Untuk Mendiagnosa Penyakit Anemia Dengan Menggunakan Metode Teorema Bayes.", Saintikom, 16(3), 284–294, 2017.

[13] Kurniawan, A., Sumijan, & Jufriadif Na'am., "Sistem Pakar Identifikasi Modalitas Belajar Siswa Menggunakan Metode Forward Chaining", Jurnal RESTI (Rekayasa Sistem Dan Teknologi Informasi), 3(3), 518–523, 2019.