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Implementation of Recommendation Systems in Determining Learning Strategies Using the Naïve Bayes Classifier Algorithm

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Abstract: Recommendation systems are widely used in various fields of life to provide suggestions for a product, service, or piece of information to someone where there is an object to choose from. The recommendation system can also be applied in the field of education, especially in improving the quality of learning that occurs in schools. In this study, developing and implementing a recommendation system was used to determine the learning strategy applied in class. The system is very necessary in order to obtain effective and efficient learning in accordance with the desired learning style of students. In addition, learning that leads to students' desire to learn can make it easier for teachers to achieve predetermined learning goals. In this study, collaborative filtering techniques based on the Naive Bayes algorithm were used to determine the learning strategy. Before carrying out the recommendation process, datasets will be collected first, which are obtained from student responses through the questionnaires provided. This data will be used as training data to obtain recommendations on learning strategies that will be applied by the teacher in the classroom. After the training data is collected, the teacher will provide a response, and the results obtained will be used as testing data. From the results of implementing a recommendation system that has been built using the Naïve Bayes algorithm, the accuracy obtained is 90.91% in determining learning strategies that are appropriate to student learning styles.

Keywords: Recommendation systems; Learning strategy; Collaborative filtering; Naïve bayes, Training data, Testing data

INTRODUCTION

The recommendation system is an application that is widely used in providing advice about a product, service, or piece of information to someone who has an object to choose from. Recommendation systems have an important role in various fields, one of which is the education sector. This system was built to be able to handle problems by providing information about what to do based on problems that are commonly faced by other users (Isinkaye et al., 2015). In the field of education, this system is widely applied to improve the quality of learning conducted by teachers and students. One application of this system is in making recommendations or predicting student performance, where the results obtained can make predictions more accurate and improve accuracy compared to predictions made traditionally using linear regression techniques (Thai-Nghe et al., 2010). In addition, the recommendation system can be used in selecting face-to-face media, which can assist teaching staff in selecting appropriate online learning media (Yolasb et al., 2022).

This research develops a recommendation system that is used in determining learning strategies in the classroom. Basically, determining learning strategies requires quite a long procedure, and it is necessary to make observations about what strategies are suitable to be applied to a material. Based on these problems, using the help of a computer-based system is able to solve problems in determining appropriate learning strategies. In addition, the system being developed requires a response from students, who will respond to their desires and the learning styles they prefer when studying the material to be provided. Each student certainly has their own type or style of receiving the material presented, but not all students understand what type of learning they need

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(Lisnawita et al., 2022). Recommendation systems in the field of education will provide useful information for making improvements to the learning process as well as an advantage in providing solutions to problems faced by users, especially in the time needed to find the best alternative (Urdaneta-Ponte et al., 2021).

Based on the previous explanation, in determining learning strategies, a recommendation system is needed in order to improve the quality of learning and make it easier for teachers to determine learning strategies that are adapted to student learning styles. A review of the literature published in recent years on recommendation systems in education has considered specific approaches and methods (Deschênes, 2020). Factors needed in making recommendations must consider the following things: the different levels of student understanding, the quality of teaching materials to be provided, and the recommended learning strategies that can cover student weaknesses. The technique often used in making recommendation systems is collaborative filtering, where the system is developed by utilizing data stored from previous users and then looking for similarities with new data or new users with the assumption that users who have similar preferences in the past tend to have the same preferences in the future.

There are many methods that can be used in making recommendation systems based on collaborative filtering techniques, one of which uses the Naïve Bayes algorithm. One of the studies on the recommendation system for predicting student final grades provides information to students and lecturers on how to improve the teaching and learning process to increase student final grades and maintain satisfactory final grades until the course is finished. From this research, the prediction of students' final grades has an accuracy rate of 93.75% by applying the Naïve Bayes algorithm (Adrian et al., 2020). There are many other machine learning techniques that can be applied in recommendation systems. Naïve Bayes is an efficient method that provides a better level of accuracy for classification results using statistical approaches and probabilistic techniques and can be applied to all types of datasets (Pandian et al., 2020).

This study proposes a recommendation system model developed with collaborative filtering techniques using the Naïve Bayes algorithm to provide recommendations in determining learning strategies. In this study, data will be collected from the results of the questionnaire that was distributed to a number of students to obtain their responses to their desires and preferred learning styles in studying the material being studied. The questionnaire given to students was in the form of a number of statements related to one of the characteristics of the proposed learning strategy that suited their wishes based on that choice. Answers or responses from students will be collected and used as training data to gain initial knowledge of the system before it can be used by the teacher to obtain recommendations. The next stage is to give a questionnaire to the teacher to get a response from the teacher according to observations in class. Responses from teachers will be collected and used as test data. The final stage of this system compares the values of the test data with the training data using the Naïve Bayes algorithm, where the test data will be entered into the system and an output value will be obtained as a result of the recommendations provided by the system.

LITERATURE REVIEW

Recommendation System

The recommendation system is a system that has been developed in order to obtain choices in dealing with a problem. This system is able to provide information according to user preferences. Various fields have implemented a recommendation system as a solution for filtering the information that will be provided to users (Nugroho et al., 2020). The process implemented in the recommendation system can be seen in Figure 1 below (Isinkaye et al., 2015).

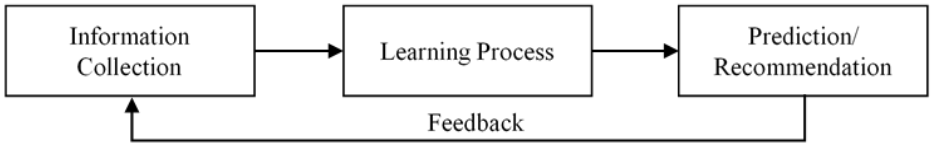

Fig. 1 Recommendation process

There are 3 recommendation system techniques that are often used, namely: Content-Based Recommender System, Collaborative Filtering-Based Recommender System, and Hybrid Recommender System (Chavan & Mukhopadhyay, 2017).

Learning Strategies

In the context of learning, strategy refers to approaches to delivering material to the learning environment. The learning strategy can also be interpreted as a pattern of learning activities that the teacher chooses and uses contextually, according to the characteristics of the students, the conditions of the school, the surrounding environment, and the learning objectives that have been formulated. Learning strategies consist of methods,

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techniques, and procedures that will guarantee that students will actually achieve learning objectives (Nasution, 2017). Learning strategies chosen by a teacher should be based on various considerations according to the situation, conditions, and environment they face. The selection of learning strategies is generally based on the following provisions: a) formulation of learning objectives that have been set; b) analysis of the needs and characteristics of the resulting learners; and c) types of learning materials communicated (Zain, 2017).

Collaborative Filtering

Collaborative filtering is a popular recommendation technique because of its ability to analyze user data, which consists of three main modules: input, recommendation algorithm, and output. Collaborative filtering is an automatic prediction (filter) about user interests by collecting preference or taste information from many users (collaborating) (Dubey & Ranjan, 2018). Collaborative filtering techniques work by building a database (a "user-item matrix") of preferences for items by users (Isinkaye et al., 2015). The advantage of using this technique is that it focuses on the similarities of users who have run into the same problem. The steps in applying this technique can be seen in Figure 2 below (Pangesti et al., 2021).

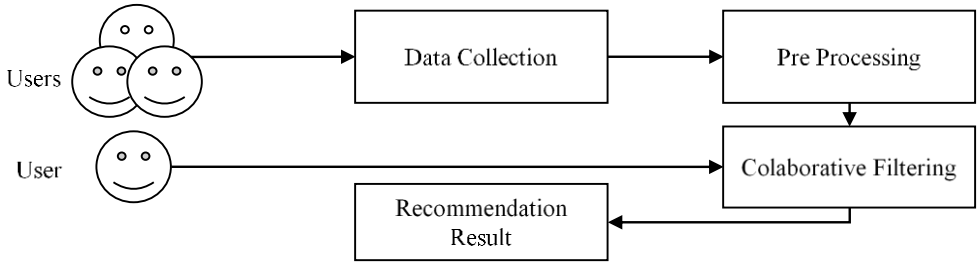

Fig. 2 Collaborative filtering process

Naïve Bayes Algorithm

One technique that can be applied in developing a recommendation system is data mining. Data mining is a method used to obtain useful information from a number of data sets using statistical, mathematical, artificial intelligence, and machine learning techniques (Kadafi, 2018). There are many machine learning techniques that can be applied in recommendation systems. The Naïve Bayes algorithm is an efficient method that provides a higher level of accuracy for classification results using statistical approaches and probabilistic techniques and can be applied to all types of datasets (Pandian et al., 2020). Naïve Bayes can solve problems including classification, clustering, association, prediction, and estimation. The Naive Bayes classifier is a collection of classification algorithms based on the Bayesian theorem (Rrmoku et al., 2022). In the recommendation system, the Naïve Bayes method will obtain the most similar Top-N user items, called neighbors. The final stage is predicting user ratings by using Top-N items that have the highest rating, which will be the result of recommendations (Puntheeranurak & Pitakpaisarnsin, 2013). The equation used can be seen in equation 1 below (Mariskhana et al., 2022).

$$P(H|X) = \frac{P(X|H)}{P(X)} x\, P(H) \quad (1)$$

Where:
P(H|X) : Probability of Hypothesis H based on Condition X (posterior probability)
P(X|H) : The probability of X is based on the conditions in the H hypothesis
P(H) : Probability hypothesis H (probability prior)
P(X) : X probability

The assumption underlying the collaborative filtering technique using the Naïve Bayes algorithm is that if user 1 has the same opinion as user 2 about a problem, then user 1 is more likely to have the same opinion as user 2 about a different problem than the opinion of a randomly selected person (Dubey & Ranjan, 2018).

METHOD

The procedures used in developing the recommendation system in this study can be seen in Figure 3 below.

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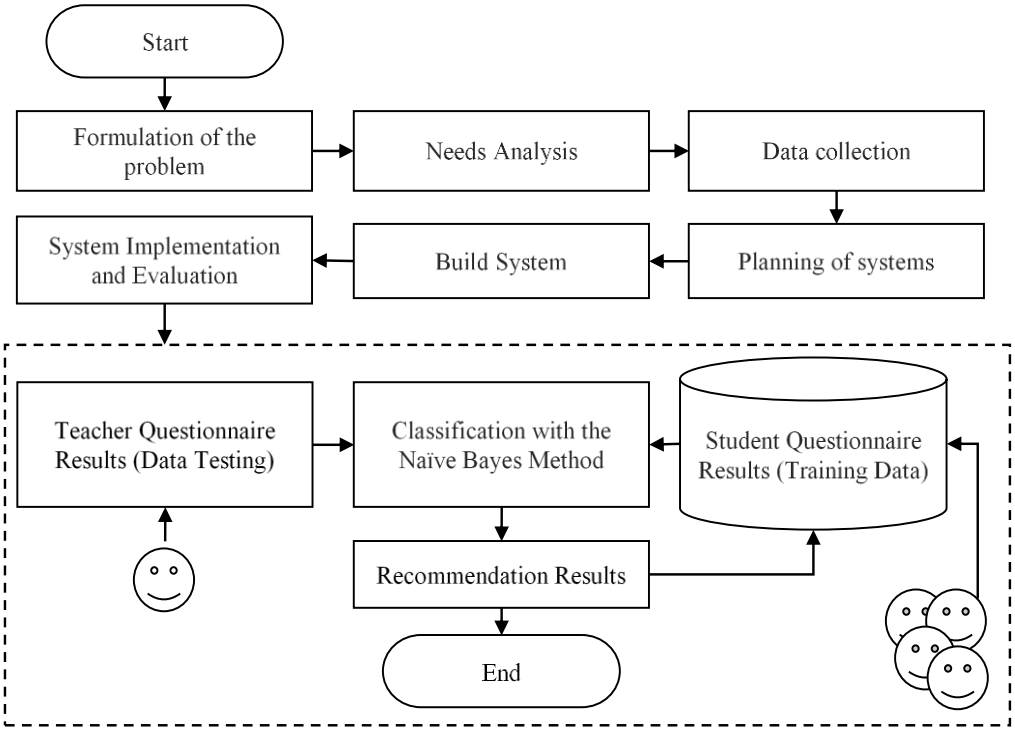

Fig. 3 Method proposed

The steps taken in developing the proposed system can be described as follows:

Formulation of the Problem

In this study, the problem proposed is the determination of learning strategies, which generally takes a long time to do the traditional way. The weakness of the traditional method is that it lacks time and knowledge for understanding the characteristics of the learning strategy to be used. Therefore, the problem in this study is how to make a recommendation system that can be applied to determining learning strategies that are in accordance with the wishes and learning styles of students.

Needs Analysis

To improve the quality of learning in schools, recommendation systems for determining learning strategies are required. This system was built to make it easier for teachers to determine the learning strategies used when carrying out the learning process. Several learning strategies are used in the 2013 Curriculum program, namely: expository (ELS), contextual (CTL), inquiry (ILS), and problem-based (PBLS) (Aji & Budiyono, 2018). A brief explanation of the characteristics of each learning strategy can be seen in Table 1 below.

Table 1. Data Description

Type Recommendations	Description
ELS (Nasution, 2020)	The expository learning strategy is a series of learning activities that emphasize conveying important facts, ideas, and information to students sourced from textbooks, references, or personal experience using lecture techniques, demonstrations, and study reports. This strategy aims to provide knowledge and skills that are considered important to students.
CTL (Surdin, 2018)	Contextual Teaching and Learning (CTL) is a learning system that fits the brain's performance to build patterns that embody meaning by connecting academic content with the context of students' daily lives. It is important to apply this so that the information received is not only stored in short-term memory, which is easily forgotten, but can also be stored in long-term memory so that it will be appreciated and

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	applied in work tasks.
ILS (Amelia & Prystiananta, 2021)	Inquiry-based learning is a way for students to develop all the skills they need to solve questions when the teacher asks them to write descriptive texts. In inquiry-based learning, students can explore their ability to express their own thoughts and feelings in texts. Before students start writing descriptive text, they look for information about the topic given by the teacher so that, without awareness, they can construct texts using all their senses.
PBLS (Pratiwi et al., 2019)	The PBL model is a learning model that uses real-world problems as the main topic for students to learn how to think critically and competently in solving problems, as well as acquire essential knowledge and concepts from the subject. Students are required to be creative and able to develop their critical thinking skills in current learning and problem solving.

Based on the characteristics of each type of learning in Table 1, 20 questionnaires were developed for research needs in response to a response from the user. Each user, in this case, the student, will fill in the statement according to their wishes and learning style.

Data Collection

The data used in this study came from students' responses to a questionnaire. The data that has been collected is from 124 students and is used as training data for initial knowledge of the system. The data collection process was carried out by counting the number of learning strategy variable items chosen by students based on their desires and preferred learning styles. The result of the sum of the questionnaire item choices will then be used as an attribute for the training process using the proposed method. The results of collecting training data from students can be seen in Table 2 below.

Table 2. Data Training

	Score	**S1**	**S2**	**S3**	**S4**	**Class**
Student 1	80	4	4	5	7	PBLS
Student 2	85	3	3	9	5	ILS
Student 3	90	6	5	4	5	CTL
…	…	…	…	…	…	…
Student 124	80	3	4	4	9	PBLS

System Planning

This process is carried out after the system requirements analysis has been fulfilled. System design is used to obtain a clear picture of the system built based on an analysis of system requirements and thinking about how to build the system. System design is a phase that requires design expertise for the computer elements used in the system to be built, namely, the selection of the equipment used and the programming language for the system. The design of the system used in building the recommendation system application can be seen using the UML (Unified Modeling Language) in Figures 4, 5, and 6 as follows.

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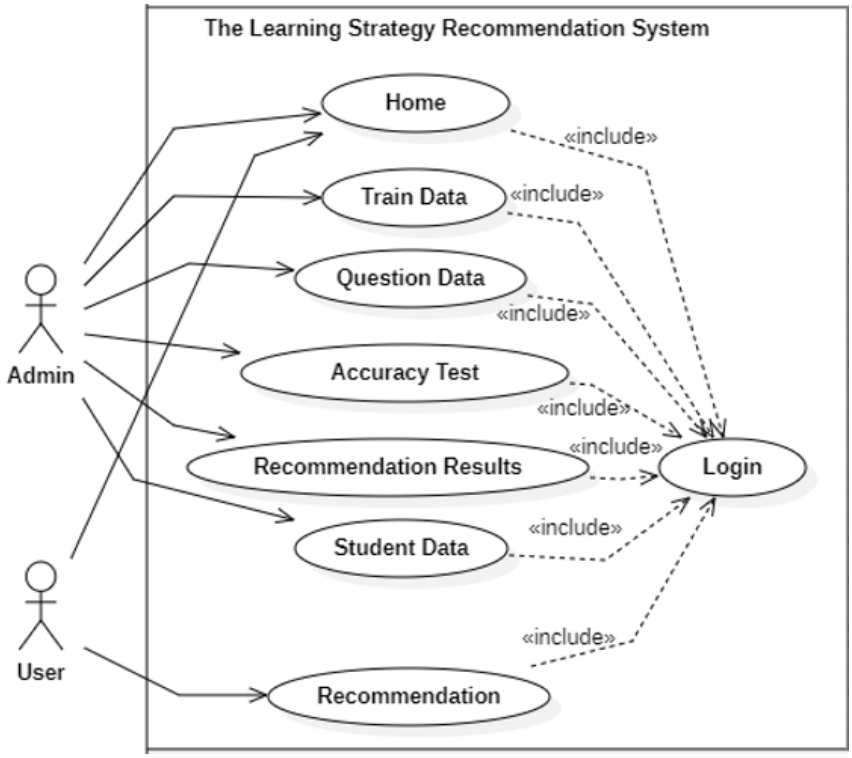

Fig. 4 Use Case Diagram

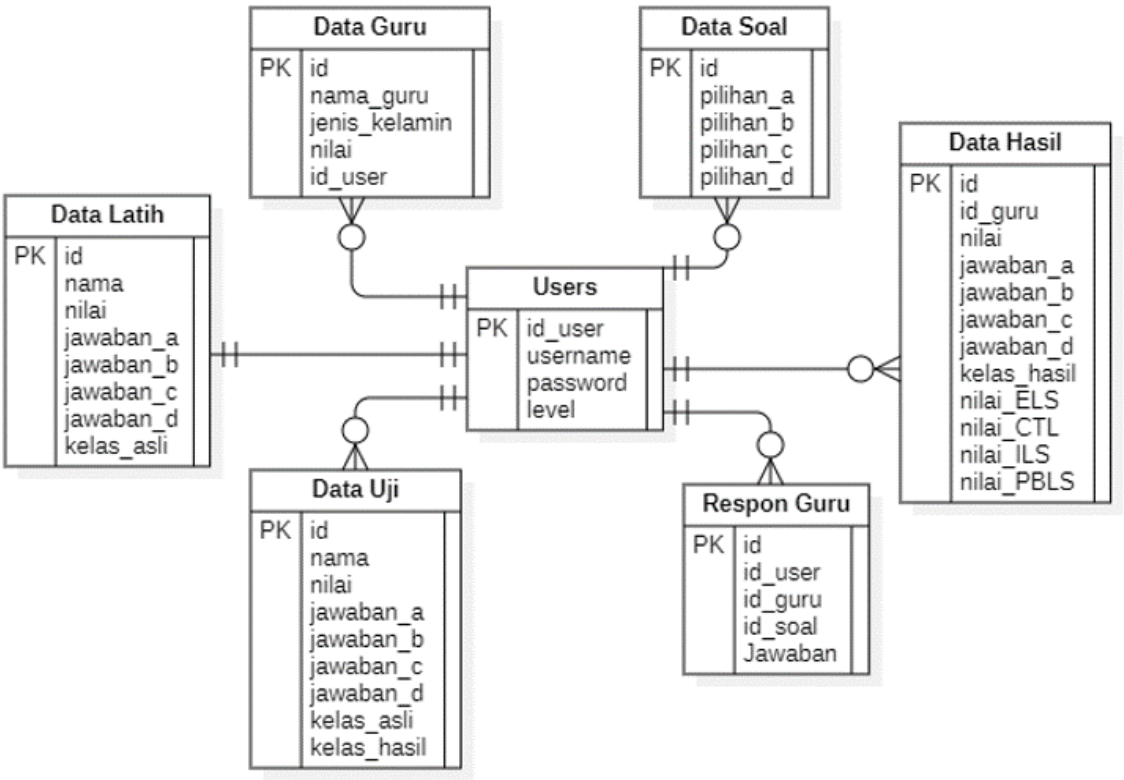

Fig. 5 Entity Relationship Diagram

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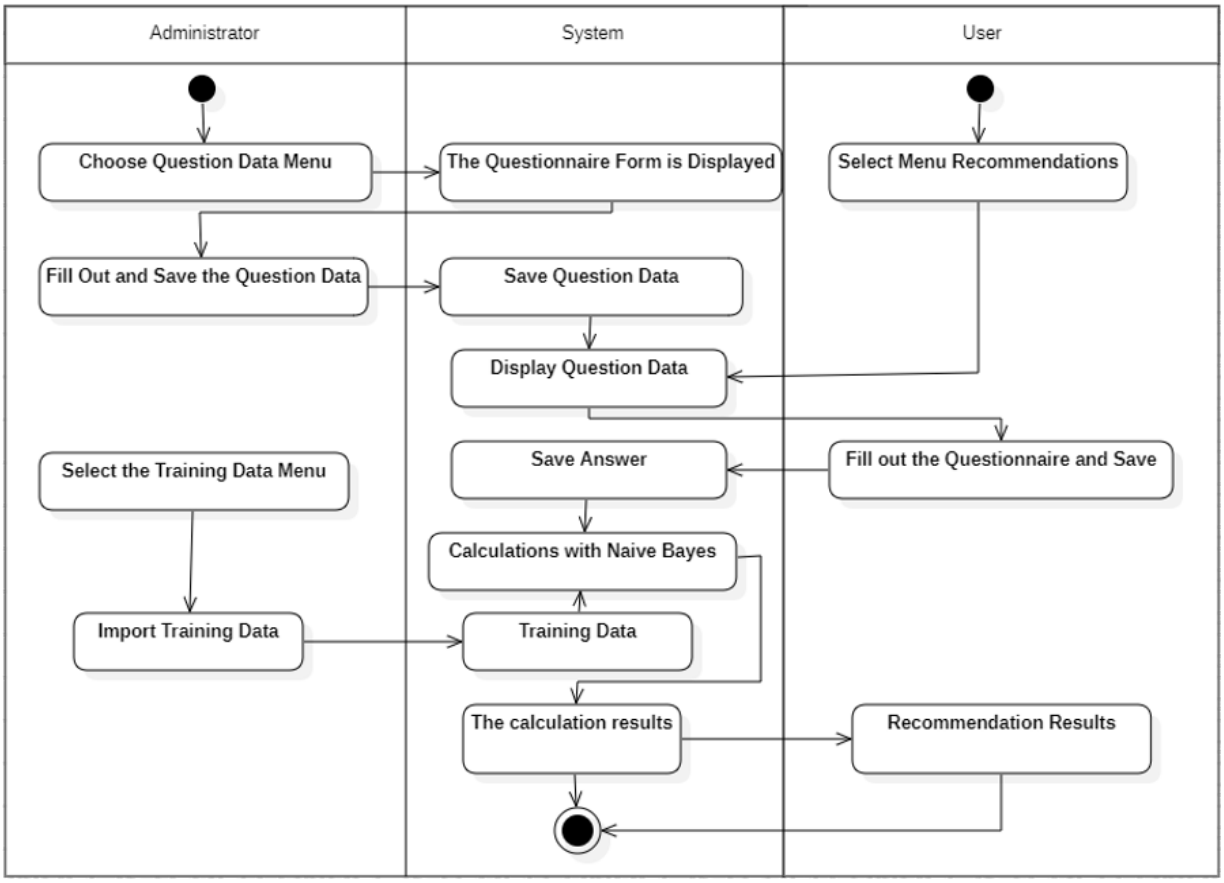

Fig. 6 Activity Diagram

System Build

This process is the realization of designing a recommendation system application in the appearance of a website-based application. In this process, system development is carried out using applications, namely Bootstrap, PHP, and MySQL, by programmers. The system is based on a pre-arranged design and can be accessed from electronic devices (computers and smartphones).

System Implementation and Evaluation

The evaluation phase can be divided into two parts, namely, the evaluation of the results of the system trial and the analysis of the trial. The results of the system trials are carried out to see all the functions of the components contained in the system that has been built, and the analysis of the system trials aims to draw conclusions from the trial results. Testing of the system is carried out in several stages that have been prepared beforehand. Testing is carried out using the black box testing technique, where the application will be tested by conducting various experiments to prove whether the components in the system that have been made are in accordance with the goals set (Pramudita, 2020). In addition, testing of the recommendation system application will also be carried out by education experts and IT experts for validation of system visualization, system functions, and system decision-making.

RESULT

Application Testing for Recommendation Systems

In implementing the recommendation system that was developed previously, the steps taken can be described as follows:

a. Log in to the application

The login display will be displayed the first time the application is run, where the user will fill in the username and password that were previously registered. Every user who registers with the system will be divided into two categories: administrators and users. Users in this application are teachers who need recommendations for determining learning strategies to be implemented in the classroom. The login display can be seen in Figure 7 below.

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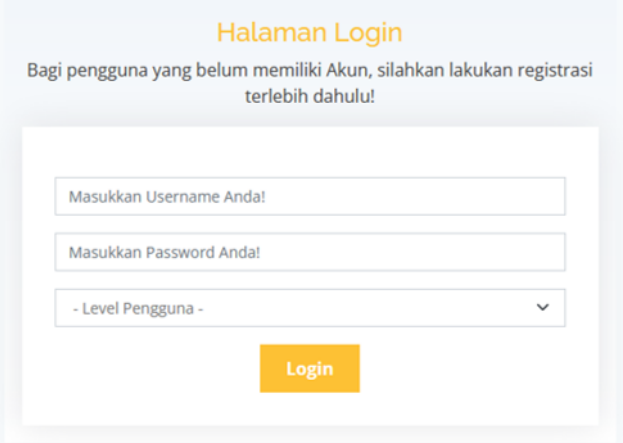

Fig. 7 Application Login View

In Figure 7, the system trial process provides valid results, where the interaction that occurs when the admin and user log in is successful.

b. Fill in the training data

Training data was obtained from data collection that had been done previously, where the data was obtained from student responses filled out through the questionnaire that had been given. This data will be entered into the database by the administrator and used when the user (teacher) wants to get recommendations for learning strategies. The display of training data can be seen in Figure 8 below.

Data Latih

Peringatan!
Data yang telah dihapus tidak dapat dikembalikan lagi.
Hapus Semua Data

Jumlah data: 124

No	Nama	Nilai	Jawaban A	Jawaban B	Jawaban C	Jawaban D	Kelas Asli
1	Siswa 1	80	4	4	5	7	PBLS
2	Siswa 2	85	3	3	9	5	ILS
3	Siswa 3	90	6	5	4	5	ELS
4	Siswa 4	65	7	5	4	4	ELS
5	Siswa 5	80	3	5	8	4	ILS

Fig. 8 Recommendation System Training Data

In Figure 8, the system trial process gives valid results, where the training data that has been entered by the admin is successfully carried out and displayed.

c. Filling out questionnaires

The questionnaire is a list of statements used to obtain research data, namely, training and testing data. The administrator will complete the process of entering data in the form of questions in order to elicit responses from users, in this case, teachers and students. The display of filled-in questionnaire data can be seen in Figure 9 below.

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Data Soal

Jumlah data: 20

No	Pilihan A	Pilihan B	Pilihan C	Pilihan D
1	Saya lebih senang mencatat dan menghafal materi pembelajaran ini	Saya lebih senang aktif berfikir, mencari dan menemukan jawaban atas pertanyaan dari guru untuk materi pembelajaran ini	Saya lebih senang aktif berfikir dan menemukan jawaban atas pertanyaan guru untuk materi pembelajaran ini	Saya lebih senang aktif berfikir, bertanya, memecahkan persoalan, dan menyimpulkan untuk pembelajaran ini
2	Saya senang jika pada materi yang disampaikan berasal dari buku ataupun pengalaman guru	Saya senang jika pada materi yang disampaikan berasal dari kehidupan nyata yang dialami	Saya senang jika pada materi yang disampaikan berasal dari pengalaman yang saya alami	Saya senang jika pada materi yang disampaikan berasal dari buku dan mengkaitannya dalam kehidupan nyata yang dialami

Fig. 9 Filling out questionnaires

In Figure 9, the process of filling in the questionnaire data in the system gives valid results, where the questionnaire data entered by the administrator is successfully carried out and displayed.

d. Fill in the response to the questionnaire

This process is carried out by the teacher as a user who needs recommendations from the system that has been built. The results of filling out the questionnaire will be used as test data carried out by the teacher, and the results will be matched with the responses given by the previous students. The display of questionnaire data can be seen in Figure 10 below.

Kuisioner Rekomendasi Strategi Pembelajaran

Baca setiap pernyataan di bawah dan pilih salah satu pernyataan yang sesuai dengan pembelajaran yang kamu senangi.

Kuisioner - 1

- ○ Saya lebih senang mencatat dan menghafal materi pembelajaran ini
- ○ Saya lebih senang aktif berfikir, mencari dan menemukan jawaban atas pertanyaan dari guru untuk materi pembelajaran ini
- ○ Saya lebih senang aktif berfikir dan menemukan jawaban atas pertanyaan guru untuk materi pembelajaran ini
- ○ Saya lebih senang aktif berfikir, bertanya, memecahkan persoalan, dan menyimpulkan untuk pembelajaran ini

Kuisioner - 2

- ○ Saya senang jika pada materi yang disampaikan berasal dari buku ataupun pengalaman guru
- ○ Saya senang jika pada materi yang disampaikan berasal dari kehidupan nyata yang dialami
- ○ Saya senang jika pada materi yang disampaikan berasal dari pengalaman yang saya alami
- ○ Saya senang jika pada materi yang disampaikan berasal dari buku dan mengkaitannya dalam kehidupan nyata yang dialami

Fig. 10 User Questionnaire Form

In Figure 10, the process of filling in the questionnaire on the system gives valid results, where the questionnaire page display is successful and saves the data that has been entered by the user.

e. Carry out the recommendation process

This process is completed by the user at the conclusion of using the built-in recommendation system. The display generated from this page is a type of learning that best fits the data derived from previous student responses. This process is carried out using the Naïve Bayes algorithm, where the highest match between the test data and the training data will be displayed as a recommendation result. The display of the recommendation results displayed by the system can be seen in Figure 11 below.

Kuisioner Rekomendasi Strategi Pembelajaran

Baca setiap pernyataan di bawah dan pilih salah satu pernyataan yang sesuai dengan pembelajaran yang kamu senangi.

Hasil prediksi = CTL

Klasifikasi Strategi Pembelajaran Anda: CTL
Probabilitas:
Nilai ELS:1.414835987734E-11
Nilai CTL:4.3548228421358E-7
Nilai ILS:4.1955330645949E-42
Nilai PBLS:8.038801750858E-44

Fig. 11 Display of recommendation results

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In Figure 11, the recommendation process shown gives valid results, where the results obtained are in the form of a recommendation of a learning strategy that has been previously entered.

Recommendation System Testing Accuracy

After the system creation stage is carried out, the next step is to run the system to obtain test data based on the teacher's response to the questionnaire given. Every teacher who wants to obtain recommendations on learning strategies requires feature scores obtained from the questionnaire answers given. The sum of the characteristics of the selected strategy is an attribute of the test data, whose results will be matched with the previous training data. Another feature required by the system is students' initial knowledge as a condition for determining appropriate learning strategies. The final stage of this system is a learning strategy recommendation obtained from the process of finding the highest similarity between the test data obtained by the teacher and the training data obtained from students using the Naïve Bayes algorithm. The results obtained in testing the system that has been built can be seen in Figure 12 as follows:

Hasil Rekomendasi :

No	Nama	Nilai	Jawaban A	Jawaban B	Jawaban C	Jawaban D	Kelas Asli	Kelas Hasil	
1	P1	70	9	3	3	5	ELS	ELS	Benar
2	P2	73	3	7	8	2	ILS	CTL	Salah
3	P3	80	4	3	6	7	PBLS	PBLS	Benar
4	P4	56	8	3	4	5	ELS	ELS	Benar
5	P5	75	4	7	5	4	CTL	CTL	Benar
.....									
40	P40	79	5	3	4	8	PBLS	PBLS	Benar
41	P41	83	3	5	7	5	ILS	ILS	Benar
42	P42	82	3	5	5	7	PBLS	PBLS	Benar
43	P43	80	5	3	8	4	ILS	ILS	Benar
44	P44	70	7	6	4	3	ELS	ELS	Benar

Jumlah prediksi: 44
Jumlah tepat: 40
Jumlah tidak tepat: 4
AKURASI = 90.91 %
LAJU ERROR = 9.09 %

Fig. 12 Testing the accuracy of recommendation systems

Based on Figure 12, the results of testing the recommendation system obtained from 44 teachers using the proposed method obtained a test accuracy of 90.91%. These results are obtained from a comparison between the original class and the resulting class issued by the system. The system that has been built gives quite good accuracy using the Naïve Bayes algorithm.

DISCUSSIONS

Based on the test results obtained from the system that has been built, a valid view is obtained as a whole. The system that has been built provides convenience in carrying out the process of recommending learning strategies, which generally requires quite a lot of time. This system can save teachers time in determining learning strategies that suit students' learning styles. Furthermore, the system that has been developed allows students to select the learning style that they prefer, while the teacher retains control over determining the appropriate learning strategy.

The determination of learning strategies can also be done by calculating student responses and applying ordinary statistical equations. However, this cannot be done because not all learning strategies can be applied to the subject matter presented by the teacher. The teacher, as a facilitator in the class, can provide control in the form of learning that can be applied through a number of statements contained in the questionnaire given. Furthermore, the system will provide an assessment of the input given by the teacher according to the wishes of the students. The recommendation results obtained from the system do not provide an absolute assessment for determining learning strategies. The final determination of the learning strategy used remains in the hands of the

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teacher. This is done because not all learning strategies can be easily applied or are in accordance with the material presented.

CONCLUSION

Based on testing of the recommendation system that has been developed, overall the appearance of the application is valid or in accordance with the previous system design. This system can be applied to obtain recommendations for learning strategies that will be carried out by teachers with ease and save time. From the results of the recommendation system that has been built using the Naïve Bayes algorithm, the accuracy obtained is 90.91% in determining learning strategies that are appropriate to student learning styles based on responses previously given through questionnaires.

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REFERENCES

Adrian, R., Perdana, M. A. J. S., Asroni, A., & Riyadi, S. (2020). Applying the Naive Bayes Algorithm to Predict the Student Final Grade. *Emerging Information Science and Technology*, 1(2), 49–57. Retrieved from https://doi.org/10.18196/eist.127

Aji, W. N., & Budiyono, S. (2018). The Teaching Strategy of Bahasa Indonesia in Curriculum. *International Journal of Active Learning*, 58(2), 58–64. Retrieved from http://journal.unnes.ac.id/nju/index.php/ijal

Amelia, M., & Prystiananta, N. C. (2021). Using Inquiry Based Learning Strategy in Teaching Writing Descriptive Text. *Linguistic, English Education and …*, 5, 1–10. Retrieved from https://journal.ipm2kpe.or.id/index.php/LEEA/article/view/2648

Chavan, R., & Mukhopadhyay, D. (2017). A comparative study of recommendation algorithms in e-commerce. *Proceedings of the International Conference on IoT in Social, Mobile, Analytics and Cloud, I-SMAC 2017*, 163–168. Retrieved from https://doi.org/10.1109/I-SMAC.2017.8058331

Deschênes, M. (2020). Recommender systems to support learners' Agency in a Learning Context: a systematic review. *International Journal of Educational Technology in Higher Education*, 17(1). Retrieved from https://doi.org/10.1186/s41239-020-00219-w

Dubey, A., & Ranjan, R. (2018). Movie Recommendation System using Naive Bayes Algorithm with Collaborative Filtering. *International Journal of Science and Research*, 9(7), 2018–2020. Retrieved from https://doi.org/10.21275/SR20603193402

Isinkaye, F. O., Folajimi, Y. O., & Ojokoh, B. A. (2015). Recommendation systems: Principles, methods and evaluation. *Egyptian Informatics Journal*, 16(3), 261–273. Retrieved from https://doi.org/10.1016/j.eij.2015.06.005

Kadafi, A. R. (2018). Perbandingan Algoritma Klasifikasi Untuk Penjurusan Siswa SMA. *Jurnal ELTIKOM*, 2(2), 67–77. Retrieved from https://doi.org/10.31961/eltikom.v2i2.86

Lisnawita, L., Guntoro, G., & Musfawati, M. (2022). Implementation of Naïve Bayes for Classification of Learning Types. *Digital Zone: Jurnal Teknologi Informasi Dan Komunikasi*, 13(1), 44–54. Retrieved from https://doi.org/10.31849/digitalzone.v13i1.9825

Mariskhana, K., Sintawati, I. D., & Widiarina. (2022). Implementation of Data Mining to predict sales of Bogo helmets using the Naïve Bayes algorithm, 7(4), 2303–2310.

Nasution, W. N. (2017). *STRATEGI PEMBELAJARAN. Medan: Perdana Publishing.*

Nasution, W. N. (2020). Expository Learning Strategy: Definition, Goal, Profit and Procedure. *IOSR Journal Of Humanities And Social Science (IOSR-JHSS*, 25(5), 7–10. Retrieved from https://doi.org/10.9790/0837-2505080710

Nugroho, R., Polina, A., & Mahendra, Y. (2020). Tourism Site Recommender System Using Item-Based Collaborative Filtering Approach. *International Journal of Applied Sciences and Smart Technologies*, 2(2), 119–126. Retrieved from https://doi.org/10.24071/ijasst.v2i2.2987

Pangesti, W. E., Suryadithia, R., Faisal, M., & ... (2021). Collaborative Filtering Based Recommender Systems For Marketplace Applications. *International Journal of …*, 1201–1209. Retrieved from https://ijersc.org/index.php/go/article/view/184

Pramudita, R. (2020). Pengujian Black Box pada Aplikasi Ecampus Menggunakan Metode Equivalence Partitioning. *INFORMATICS FOR EDUCATORS AND PROFESSIONAL : Journal of Informatics*, 4(2), 193. Retrieved from https://doi.org/10.51211/itbi.v4i2.1347

Pratiwi, H. Y., Ain, N., & Igut, H. J. (2019). The Implementation of Problem Based Learning Model to Improve

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Student's Motivation and Critical Thinking. *Berkala Ilmiah Pendidikan Fisika*, 7(3), 177. Retrieved from https://doi.org/10.20527/bipf.v7i3.6519

Puntheeranurak, S., & Pitakpaisarnsin, P. (2013). Time-aware Recommender System Using Naïve Bayes Classifier Weighting Technique. *Proceedings of the 2nd International Symposium on Computer, Communication, Control and Automation*, 68(3ca), 266–269. Retrieved from https://doi.org/10.2991/3ca-13.2013.66

Rrmoku, K., Selimi, B., & Ahmedi, L. (2022). Application of Trust in Recommender Systems—Utilizing Naive Bayes Classifier. *Computation*, 10(1). Retrieved from https://doi.org/10.3390/computation10010006

Surdin. (2018). The Effect of Contextual Teaching and Learning (CTL) Models on learning outcomes of Social Sciences of the material of forms the face of the earth on Class VII of Junior High School. *International Journal of Education and Research*, 6(3), 57–64. Retrieved from http://ijern.com/March-2018.php

Thai-Nghe, N., Drumond, L., Krohn-Grimberghe, A., & Schmidt-Thieme, L. (2010). Recommender system for predicting student performance. *Procedia Computer Science*, 1(2), 2811–2819. Retrieved from https://doi.org/10.1016/j.procs.2010.08.006

Urdaneta-Ponte, M. C., Mendez-Zorrilla, A., & Oleagordia-Ruiz, I. (2021). Recommendation systems for education: Systematic review. *Electronics (Switzerland)*, 10(14). Retrieved from https://doi.org/10.3390/electronics10141611

V, P. C., Pandian V, V. P., Kumar V, V. K., & Bharathi V, S. M. (2020). Recommendation System Using Naive Bayes Classifier. *International Research Journal of Engineering and Technology*, 5507–5510. Retrieved from www.irjet.net

Yolasb, E. Y., Sitanayah, L., & Kumenap, V. D. (2022). Rekomendasi Pemilihan Media Tatap Muka Pembelajaran Daring Menggunakan Metode ELECTRE. *JOINTER : Journal of Informatics Engineering*, 3(01), 1–9. Retrieved from https://doi.org/10.53682/jointer.v3i01.51

Zain, M. (2017). Pengembangan Strategi Pembelajaran Dan Pemilihan Bahan Ajar. *Inspiratif Pendidikan*, 6(1), 172. Retrieved from https://doi.org/10.24252/ip.v6i1.4925

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