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Literature Study: Predicting the Type of Company Students Work for Using Naïve Bayes and Neural Network Algorithms

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Abstract

This research was conducted to evaluate the effectiveness of various machine learning algorithms, such as Naive Bayes, Support Vector Machine, Random Forest, and Artificial Neural Network (ANN), in predicting and classifying data. Naive Bayes has proven to be efficient and accurate in structured data classification, such as predicting alumni job waiting time (94%) and vocational school students' job readiness (96.95%). On the other hand, neural network methods like ANN and GRNN are superior in handling nonlinear regression problems, such as house price prediction or student study duration, although there is still room for improving accuracy. Random Forest is more suitable for complex data, while Naive Bayes is more effective for simple data. This study emphasizes the importance of selecting relevant variables, such as gender, major, and GPA, to enhance model performance. Therefore, the selection of machine learning methods should be tailored to the type of data and the analysis objective, as each algorithm has its own strengths and limitations

Keywords: ***Naïve Bayes; Neural Network; prediction; career; employment; company***

Abstrak

Penelitian dilakukan untuk mengevaluasi efektivitas berbagai algoritma machine learning, seperti Naive Bayes, Support Vector Machine, Random Forest, dan Artificial Neural Network (ANN), dalam memprediksi dan mengklasifikasikan data. Naive Bayes terbukti efisien dan akurat dalam klasifikasi data terstruktur, seperti memprediksi waktu tunggu alumni untuk mendapatkan pekerjaan (94%) dan kesiapan kerja siswa SMK (96,95%). Di sisi lain, metode jaringan syaraf seperti ANN dan GRNN lebih unggul dalam menangani masalah regresi non-linear, seperti prediksi harga rumah atau masa studi mahasiswa, meskipun masih ada ruang untuk meningkatkan akurasi. Random Forest lebih cocok untuk data yang kompleks, sedangkan Naive Bayes lebih efektif untuk data yang sederhana. Penelitian ini menekankan pentingnya pemilihan variabel yang relevan, seperti jenis kelamin, jurusan, dan IPK, untuk meningkatkan kinerja model. Oleh karena itu, pemilihan metode machine learning harus disesuaikan dengan jenis data dan tujuan analisis, karena setiap algoritma memiliki kelebihan dan kekurangannya masing-masing.

***Kata-kata kunci**: Naïve Bayes; Neural Network; prediksi; karir; Bekerja; Perusahaan*

1. Introduction

For graduating students, choosing a workplace is one of the most important decisions in the modern technological era. A company's reputation, work culture, and career prospects are among the many reasons why students choose certain companies. By utilizing algorithms such as Naïve Bayes and Neural Networks, research has become highly relevant in understanding patterns and trends in students' career choices. Current data can be analyzed in this way to provide better guidance for students in selecting a workplace that aligns with their interests and skills.

A tracer study is an essential activity for universities to track the career paths of graduates within a certain period after completing their education. This study aims to collect and provide data for universities to improve graduate absorption into the industrial world, ensure curriculum relevance to industry needs, and identify competencies required in the labor market. According to **[1]**, tracer studies can provide comprehensive information regarding job compatibility—both horizontally across various fields of study and vertically according to educational levels. In addition, tracer studies serve as a tool to evaluate the teaching methods used in education, by examining the extent to which university education contributes to the professional careers of graduates **[2].**

Based on an interview with Syarif Hidayat, S.Si., M.T., Manager of the Career and Alumni Service Division at Institut Teknologi PLN (2025), it was revealed that ITPLN has conducted tracer studies by collecting data from alumni regarding their career paths after graduation. This data is used to evaluate curriculum relevance and to support both current students and alumni in becoming competitive in the job market. However, many students still struggle to determine which skills they need to develop to meet industry demands and their desired career goals. This clearly poses a challenge in bridging the gap between academic and professional worlds, leaving students often without a clear understanding of the skills required in various job fields. Students tend to focus solely on academic grades but may lack awareness of additional skills such as critical thinking, problem-solving, digital literacy, technical abilities, and others.

To predict the most relevant skills based on tracer studies, artificial intelligence-based data analysis methods such as Naive Bayes and Neural Network can be employed. According to a study by **[3]** the use of Naïve Bayes in data classification shows relatively high accuracy,

especially in cases where the data contains many features. On the other hand, Neural Networks are also powerful methods for processing large and complex datasets. With their ability to learn from data through layers of neurons, Neural Networks can detect patterns that might be invisible to other algorithms. Research by [4] shows that Neural Networks have been successfully applied in various fields, including pattern recognition and classification. By combining Naive Bayes and Neural Network approaches, more comprehensive results can be achieved in predicting the type of company where students are likely to find employment.

Therefore, this research is conducted to help ITPLN students identify the skills they need to acquire in order to join their dream companies. A predictive system is needed to address this gap by providing students with more accurate, data-driven information about the competencies most valued in the job market. With this predictive system, students can receive more specific recommendations on the competencies they should improve, enabling them to better prepare for the workforce and increase their chances of being hired by desirable companies.

2. Method

This section highlights the importance of using a clear research method to ensure that the study remains focused. The following research employs a systematic literature review approach to ensure the validity and relevance of selected journals. The process of searching and filtering journals follows these steps: first, identifying relevant keywords based on the research topic, such as Naïve Bayes, Neural Network, prediction, career, employment, company. Therefore, I conducted a step-by-step selection process to find relevant studies, which can be seen **Figure 1.**

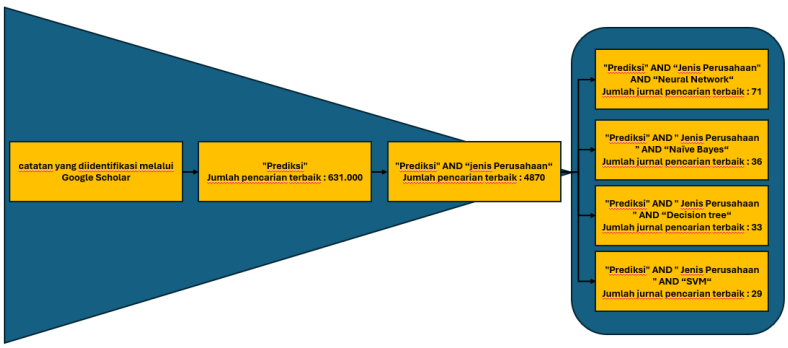

Figure 1. Research Stages – Topic Identification

Based on journal searches on Google Scholar, the initial search using the keyword "Prediction" yielded 631,000 results. However, after adding the keyword "Company Type," the number narrowed down to 4,870 journals. Further refinement with the keyword "Career" resulted in 305 publications. By including specific prediction methods, the best journals were filtered as follows:

- "Prediction" AND "Company Type" AND "Neural Network" resulted in 71 journals
- "Prediction" AND "Company Type" AND "Naïve Bayes" resulted in 36 journals
- "Prediction" AND "Company Type" AND "Decision Tree" resulted in 33 journals
- "Prediction" AND "Company Type" AND "SVM" resulted in 29 journals

After identifying several research references based on the topic to be discussed, the author screened 10 relevant journals that met the criteria of applying either the Naïve Bayes or Neural Network method.

3. Results and Discussion

Previous studies have not yet combined both the Neural Network and Naïve Bayes algorithms for segmentation tasks, although both are well-known for their excellent predictive capabilities—especially for complex and nonlinear data. The author carefully selected and reviewed previous journals. To facilitate categorization, keywords such as Naïve Bayes, Neural Network, prediction, career, employment, and company were used.

Table 1. Literature Review Results on the Application of Naïve Bayes and Neural Network Methods

Numb	Title	Author and Year of publication	Method	Result Research
1	The title of the research is 'House Price Prediction Using the General Regression Neural Network Method'.[5]	Febrion Rahayuningtyas Evi, Novia Rahayu F, Azhar Y Pada tahun 2021	The method used is General Regression Neural Network.	In the study conducted using actual data and predictive variables visualized in the form of a line plot, accurate testing was also performed to evaluate the

Numb	Title	Author and Year of publication	Method	Result Research
				model's performance using three evaluation methods. The results of the study showed that the Mean Squared Error (MSE) was 58.72, the Root Mean Squared Error (RMSE) was 7.66, and the Mean Absolute Error (MAE) was 5.99.
2	Research Title: "Classification Analysis of Tracer Study Data Using Support Vector Machine and Neural Network Methods [6]	Authors of this study: Drajat Indra Purnama Rahmi Lathifah Islami Lisna Sari Pardomuan Robinson Sihombing (Year: 2021)	This research employed the following methods: Support Vector Machine (SVM) Neural Network	Based on the results of this study, I conclude that the identification process of tracer study data related to graduate absorption—categorized as "smooth" and "not smooth"—produced nearly equal accuracy results. The BPNN model achieved an accuracy of 83.33%, while the SVM model achieved 83.00%, with only a 0.33% difference.

Numb	Title	Author and Year of publication	Method	Result Research
3	The third research title is "Machine Learning Classification Model for Career Placement Accuracy Prediction" [7]	The authors of this study are: 1. Hendri Mahmud Nawawi 2. Agung Baitul Hikmah 3. Ali Mustopa 4. Ganda Wijaya Published in 2024.	This study employs the following methods: 1. algoritma Machine Learning (ML) 1. ML classification models a. Random Forest b. b. Decision Tree c. c. Naïve Bayes d. d. KNN (K-Nearest Neighbors) e. e. SVM (Support Vector Machine)	In this study, among the models tested, the Random Forest model showed the highest performance, achieving an accuracy of approximately 87%. In contrast, the SVM method had the lowest performance, with an accuracy of only 67%.
4	The title of the study is "Application of the Naïve Bayes Algorithm for Predicting the Waiting Time of Alumni in Obtaining Employment, Conducted at the Royal STMIK Career Service Center." [8]	The authors of this study are: 1. Tasyia Dita Aulia 2. Yessica Siagian 3. Pristiyanilicia Putri Published in 2023	algoritma naive bayes	The results of the study using the Naïve Bayes method achieved an accuracy of 94%. The variables used in this research include: Gender Major Entry Year Graduation Year GPA (Grade Point Average) Waiting Time
5	The title of this research is "Application of Naïve Bayes for Predicting Student Graduation in	May Sinta Samosir, Lidya Wati Published in 2024	algoritma naive bayes	The graduation prediction results from the Naïve Bayes algorithm show a precision of 92.31%, recall of

Numb	Title	Author and Year of publication	Method	Result Research
	the Software Engineering Program at Politeknik Negeri Bengkalis."[9]			80%, and accuracy of 76.47% using a training-to-testing data ratio of 90% and 10%.
6	The following research title focuses on "Backward Elimination-Based Naïve Bayes Algorithm for Predicting Work Readiness in Vocational High School (SMK) Students." [10]	The author of this study is Husni Hidayat , published in 2021	algoritma naive bayes	The results of this study using the Naïve Bayes method achieved a high accuracy of 95.55%. Furthermore, in the second testing phase using Backward Elimination, the accuracy increased even further to 96.95%. Therefore, it can be concluded that applying this method—by eliminating irrelevant variables—yields better results compared to using the Naïve Bayes method alone.
7	The title of this research discusses: "Implementation of the Naïve Bayes Algorithm for Classifying the Employment	The authors of this study are: Gabby Silvia Amanda Muhamad Aditya Purnama Published in 2024.	algoritma naive bayes	The results of the testing conducted in this study using a classification method for alumni employment

Numb	Title	Author and Year of publication	Method	Result Research
	Status of Alumni at Binary Academy"[11]			criteria showed that both employed and unemployed graduates received the same score of 0.562. Meanwhile, the Correct Classification Accuracy (CA) rate was 0.621. Therefore, it is necessary to use appropriate variables when applying this model to improve its performance and accuracy.
8	The following study examines: "Prediction of Undergraduate Study Duration using Artificial Neural Networks." [12]	The authors of this study are: 1. Muhammad Hanief Meinanda 2. Metri annisa Narendi Muhandri 3. Kadarsyah Suryadi Published in 2009	The methods used are: 1. Regresi 2. Artificial Neural Network	The results of this study show that using variables such as GPA, the number of courses taken, and repeated courses, the regression method was considered less accurate in predicting students' study duration. In contrast, the ANN (Artificial Neural Network) method proved to be more

Numb	Title	Author and Year of publication	Method	Result Research
				accurate in predicting the length of study.
9	The following research is entitled "Application of the Naïve Bayes Algorithm for Employee Acceptance Prediction." [13]	The authors of this study are: 1. Intan Murni Pratiwi 2. Ahmad Fauzi Santi Arum Puspita Lestari 3. Yana Cahyana Published in 2024	algoritma naive bayes	In this study, the Naïve Bayes method was applied to predict employee acceptance, achieving a result of 97.14%. This outcome demonstrates that the predictive performance of the model is highly accurate.
10	Decision Support System for Promotion Decisions Using the Naive Bayes Method (Case Study: PT Buana Mulia Indonesia)[14]	The authors of this study are: 1. Ajeng Maryana Nugroho Putri, 2. Alvino Octaviano Published in 2023	Metode Naïve bayes	The Naïve Bayes method was implemented by calculating class probabilities. Validation was performed using the Confusion Matrix method, which involved calculating probabilities using the Gaussian function, along with accuracy, precision, and recall. The results achieved an accuracy of

Numb	Title	Author and Year of publication	Method	Result Research
				80%, helping to determine which employees are eligible or not eligible for a promotion.

According to a systematic literature review (SLR) encompassing ten studies examining how machine learning algorithms are applied in various fields—such as GRNN, SVM, Naïve Bayes, and classification models like Random Forest and Decision Tree—it was found that the Naïve Bayes method is frequently used. Therefore, it can be considered quite effective.One of the topics discussed in the review table focuses on the application of the Naïve Bayes method in predicting student graduation in the Software Engineering program at Politeknik Negeri Bengkalis. This study, conducted in 2024, employed the Naïve Bayes method for prediction purposes. The research achieved a prediction result with a precision rate of 92.31%, recall of 80%, and accuracy of 76.47% using a training-to-testing data ratio of 90% and 10%, respectively. The results of this study prove that the method used is capable of producing accurate outcomes for making predictions. This indicates that Naïve Bayes can serve as an effective tool for processing predictive analytics.

Another study utilizing the GRNN method to predict house prices yielded an MSE value of 58.72, RMSE of 7.66, and MAE of 5.99. In predicting employment success among alumni, the Backpropagation Neural Network (BPNN) model achieved an accuracy of 83.33%, while SVM reached an accuracy of 83.00%. The Random Forest model proved superior in predicting career placement accuracy, achieving an accuracy of 87% and an AUC/ROC value of 0.93. Meanwhile, the Naïve Bayes algorithm demonstrated excellent performance across various cases, such as predicting alumni job waiting time with up to 94% accuracy, and employee acceptance prediction with an accuracy of 97.14%.

Overall, these machine learning algorithms have shown promising results in predicting various outcomes, including student graduation, alumni job waiting time, vocational students' work readiness, and housing prices. The studies also highlight the importance of selecting

relevant features—such as gender, major, and GPA—to improve the accuracy of predictive models.

4. Conclusion

Based on the discussion conducted, the Naïve Bayes and Neural Network methods are effective and efficient for classification and prediction purposes. Overall, these machine learning algorithms have shown promising results in predicting various aspects such as house prices, student graduation, alumni job waiting time, and vocational students' work readiness. This study also highlights the importance of selecting relevant features—such as gender, major, GPA, and other related factors—to improve the accuracy of predictive models.

As a result of the literature review conducted, various machine learning techniques have been applied to analyze alumni data, predict housing prices, and support decision-making across different industries. The studies reviewed indicate that the choice of method depends on the type of data used and the research objectives, with each method having its own strengths and limitations. Several studies employed neural network-based methods and have proven effective in handling regression problems such as predicting house prices or student study duration. For instance, GRNN was able to predict house prices with reasonably good results, although its error values (MSE of 58.72) can still be improved.

On the other hand, due to its efficiency and simplicity, the Naïve Bayes algorithm has become one of the most popular classification techniques. Research has shown that Naïve Bayes is capable of delivering high accuracy in several cases. For example, it successfully predicted alumni job waiting times with 94% accuracy and vocational students' work readiness at 96.95% after applying Backward Elimination feature selection. It even achieved an impressive 97.14% accuracy in predicting employee acceptance. However, not all methods yield optimal results. For example, SVM with a linear kernel in one study only reached an accuracy of 67%, demonstrating that parameter selection and kernel type significantly influence model performance.

In general, these studies show that the type of data and analysis objective should determine the choice of machine learning method. While Random Forest performs better with more complex data, Naïve Bayes excels in classifying structured and simpler datasets. For regression problems or predictions involving non-linear data patterns, neural networks such as

ANN or GRNN are more suitable. The explanation provided in this narrative style is easier to understand and feels more natural, as if explained by a person, without compromising the depth of information conveyed.

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