

***A COMPARATIVE STUDY OF STUDENT SATISFACTION  
LEVELS ON ONLINE LEARNING USING K-NN AND NAÏVE  
BAYES***

**TUGAS AKHIR**

Diajukan Sebagai Salah Satu Syarat  
untuk Memperoleh Gelar Sarjana Komputer pada  
Program Studi Sistem Informasi

Oleh:



**HILDA MUTIARA NASUTION**

**11950324870**



**FAKULTAS SAINS DAN TEKNOLOGI  
UNIVERSITAS ISLAM NEGERI SULTAN SYARIF KASIM RIAU  
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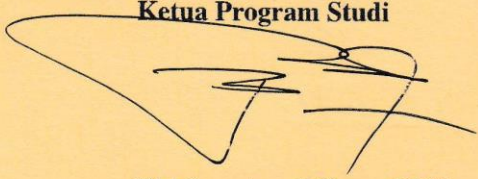
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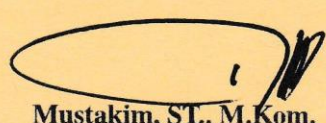
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LEVELS ON ONLINE LEARNING USING K-NN AND NAÏVE  
BAYES***


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## LEMBAR PERSEMBAHAN



*Assalamu 'alaikum Warahmatullahi Wabarakatuh*

*Alhamdulillah Rabbil 'Alamin*, segala puji bagi Allah *Subhanahu Wa Ta'ala*. atas nikmat, kesehatan, taufik dan hidayah serta ilmu pengetahuan yang telah Engkau limpahkan. Dengan Rahmat-Mu Tugas Akhir ini dapat terselesaikan. Tidak lupa shalawat dan salam saya ucapkan kepada Nabi Muhammad *Shallallahu 'Alaihi Wa Sallam* dengan mengucapkan "*Allahumma Sholli 'ala Sayyidina Muhammad Wa 'ala Ali Sayyidina Muhammad*".

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*Wassalamu 'alaikum Warahmatullahi Wabarakaatuh*

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*Assalamu 'alaikum Warahmatullahi Wabarakatuh*

*Alhamdulillah Rabbil 'Alamin*, puji syukur penulis ucapkan kehadiran Allah *Subhanahu Wa Ta'ala*, atas izin dan karunia-Nya penulis dapat melaksanakan serta menyelesaikan Tugas Akhir ini dengan judul "A Comparative Study of Student Satisfaction Levels on Online Learning Using K-NN and Naïve Bayes". Tugas Akhir ini disusun untuk memenuhi salah satu syarat untuk memperoleh Gelar Sarjana Komputer pada Program Studi Sistem Informasi Fakultas Sains dan Teknologi Universitas Islam Negeri Sultan Syarif Kasim Riau. Pada kesempatan ini penulis ingin menyampaikan ucapan terima kasih khususnya kepada Ayahanda Mukhtar Yahya dan Ibunda Nenny Elita yang selalu mendukung dan mendoakan yang terbaik serta menjadi penyemangat dalam hidup bagi penulis. Tidak lupa pula penulis juga ucapkan terima kasih kepada:

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9. Seluruh Dosen dan Karyawan Program Studi Sistem Informasi Fakultas





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10. Untuk orangtua dan saudara-saudari penulis yang menjadi penyemangat selama pengerjaan Tugas Akhir ini.
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Penulis menyadari bahwa dalam penulisan Tugas Akhir ini masih jauh dari kata sempurna. Oleh karena itu, kritik dan saran yang membangun sangat diharapkan untuk kesempurnaan Tugas Akhir ini.

*Wassalamu'alaikum Warahmatullahi Wabarakatuh*

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 : Letter of Acceptance

Medan, 07 June 2023

Dr./Ms. **Hilda Mutiara Nasution**

Assalamu'alaikum Wr. Wb

We would like to express our sincere gratitude for your participation in submitting an article to the Journal of Informatics and Telecommunication Engineering (JITE). We hereby inform you that the article listed below:

<b>Paper</b>	: <b>A Comparative Study of Student Satisfaction Levels on Online Learning Using K-NN and Naïve Bayes</b>
<b>Authors</b>	: <b>Hilda Mutiara Nasution, Mustakim, Inggih Permana and M. Afdal</b>

Based on the review results, the article you submitted has been ACCEPTED to be published in JITE Journal Volume 7 Number 1, July 2023 ISSN: 2549-6247 (Print) ISSN: 2549-6255 (Online).

We would like to thank you for your attention and cooperation.

Wassalamu'alaikum Wr. Wb.



Best Regards,

**Muhathir, ST., M.Kom**  
 Chief Editor



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## A Comparative Study of Student Satisfaction Levels on Online Learning Using K-NN and Naïve Bayes

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### Abstrak

Merebaknya pandemi Covid-19 di Indonesia menyebabkan pembatasan aktivitas sosial manusia untuk meminimalisir penularan. Kegiatan belajar-mengajar juga terdampak ketika siswa harus tinggal di rumah dan mengikuti pembelajaran jarak jauh berdasarkan Peraturan Pemerintah Nomor 21 Tahun 2020, kebijakan Pembatasan Sosial Berskala Besar (PSBB), yang dikeluarkan pada tanggal 31 Maret 2020. Hal ini mendorong munculnya aplikasi-aplikasi pendukung pembelajaran seperti Zoom, Google Classroom, Google Meet, E-Learning, dan masih banyak lagi. Namun, budaya belajar yang baru ini membutuhkan adaptasi agar dapat diimplementasikan secara efektif. Dalam proses adaptasi tersebut, peneliti ingin mengukur tingkat kepuasan mahasiswa dan mencari tahu algoritma terbaik untuk mengklasifikasikan tingkat kepuasan mahasiswa. Pengukuran ini menggunakan dua algoritma data mining yaitu K-Nearest Neighbor (K-NN) dan Naïve Bayes, dengan mahasiswa Universitas Islam Negeri Sultan Syarif Kasim Riau sebagai objek penelitian. Algoritme yang berbeda memiliki kekuatan dan kelemahan yang berbeda-beda dalam menangani jenis data dan tugas klasifikasi tertentu. Dengan membandingkan kedua algoritma tersebut, kita dapat menilai kemampuan generalisasinya. Sebuah model yang berkinerja baik pada data pelatihan tetapi gagal menggeneralisasi ke data yang tidak terlihat mungkin tidak seefektif algoritme yang lebih kuat yang menunjukkan kinerja generalisasi yang lebih baik. Klasifikasi K-NN dengan nilai  $k = 3$  mendapatkan hasil yang baik. Berdasarkan hasil penelitian diperoleh kesimpulan bahwa K-NN lebih optimal dalam mengklasifikasikan tingkat kepuasan mahasiswa dibandingkan dengan Naïve Bayes dengan perbandingan akurasi sebesar 85% : 80%, precision sebesar 85% : 84%, dan recall sebesar 99% : 93%.

**Kata Kunci:** Klasifikasi, Perbandingan, K-NN, Naïve Bayes, Tingkat Kepuasan

### Abstract

The outbreak of the Covid-19 pandemic in Indonesia led to restrictions on human social activities to minimize transmission. Teaching-learning is also affected when students must stay home and follow distance learning based on Government Regulation Number 21 of 2020, the Large-Scale Social Restrictions (PSBB) policy, issued on March 31, 2020. This has led to the emergence of learning support applications such as Zoom, Google Classroom, Google Meet, E-Learning, and many more. However, this new learning culture requires adaptation for effective implementation. During the adaptation process, researchers want to measure the level of student satisfaction and find out the best algorithm for classifying the level of student satisfaction. This measurement uses two data mining algorithms, K-Nearest Neighbour (K-NN) and Naïve Bayes, and the Islamic State University of Sultan Syarif Kasim Riau students as the research object. Different algorithms have varying strengths and weaknesses in handling specific data types and classification tasks. By comparing both algorithms, we can assess their generalization capabilities. A model that performs well on training data but fails to generalize to unseen data may not be as effective as a more robust algorithm that exhibits better generalization performance. K-NN classification with a value of  $k = 3$  gets good results. Based on the study results, the conclusion is that K-NN is more optimal in classifying student satisfaction levels than Naïve Bayes with an accuracy ratio of 85% : 80%, precision of 85% : 84%, and recall of 99% : 93%.

**Keywords:** Classification, Comparison, K-NN, Naïve Bayes, Satisfaction Level

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## INTRODUCTION

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) outbreak, which is the cause behind the Covid-19 phenomenon, began in Wuhan, Hubei Province, China, on January 26, 2020 (Wu et al., 2020). As of August 17, 2022, in Indonesia, 6,297,484 people have been infected, and 157,296 people have died (World Health Organization Indonesia, 2022). Government Regulation Number 21 of 2020, the Large-Scale Social Restrictions (PSBB) policy, was issued on March 31, 2020. The Covid-19 pandemic has brought unprecedented disruption to the world of education, with school closures impacting 1.2 billion learners and adolescents worldwide (UNESCO, 2020).

Students are confined to their homes due to the application of an online learning system that aims to minimize the transmission of the virus. This new educational culture led to the emergence of alternative applications supporting distance learning, such as Zoom, Google Classroom, e-Learning, Microsoft Teams, Google Meet, and many more. E-learning has become a significant force in education and has been implemented on a large scale in higher education (Al-fraihat et al., 2020). Unfortunately, many educational institutions, educators, and students need more time to prepare for this new experience (Maqableh & Alia, 2021).

Delivering knowledge during the pandemic has become a new challenge, and many lecturers are still designing the best approaches and solutions to overcome this crisis. Similar to traditional learning in general, e-learning also provides a cooperative spirit of collaboration via the online platform and a sense of "togetherness" (Prasetyo et al., 2021). Distance learning at the Islamic State University of Sultan Syarif Kasim Riau lasted for  $\pm$  5 academic semesters. During that time, almost 26,459 students accessed supporting applications. In e-learning, lecturers can give instructions to students, upload learning materials, and create a place to collect assignments and deadlines.

By measuring student satisfaction, educational institutions can gain valuable insights, which enables them to identify areas needing improvement and make necessary adjustments to enhance the learning experience. By understanding student difficulty, instructors can adapt their teaching strategies to better align with students' preferences and needs. Ensuring student satisfaction can enhance an institution's brand image, help institutions meet accreditation requirements, and showcase their commitment to providing high-quality online education.

However, on the other hand, according to (Hasan & Bao, 2020), (González-Betancor et al., 2021), and (van de Werfhorst et al., 2022), during the pandemic, there are specific gaps in digital learning. The digital imbalance and lack of access to new technology are perceived to make it difficult for students from low-income communities. Not all students live in areas that have internet coverage. Technical issues such as poor internet connectivity or platform glitches may disrupt the learning process. Online learning can cause feelings of isolation as students miss out on social interactions found in traditional classrooms. The lack of face-to-face contact with peers and instructors may impact student satisfaction. Unlike face-to-face learning, online learning usually relies on digital communication tools. While video conferencing and chat platforms can provide some level of interaction, they cannot completely replace the benefits of face-to-face communication. The reduced ability to ask questions in real-time or engage in spontaneous discussions can impact student satisfaction.

Online learning requires students to manage their time effectively. The absence of a fixed schedule can be challenging for students who struggle with discipline. These challenges can negatively impact student satisfaction. Although the Covid-19 pandemic in some countries has improved, including Indonesia, evaluating online learning is very important. Online learning is an alternative to learning during the pandemic. Still, it must evaluate to improve its effectiveness as a more flexible learning option. In the face of the possible permanence of online learning implementation, there needs to be clear regulations and standards to ensure good quality of online learning. Data mining is required to classify student satisfaction levels with online learning. Data mining is the extraction of procedural modalities and other helpful information from sizable data sets (Mostafa & Mahmoud, 2022).

Classification techniques in data mining are suitable for preparing much information and are used to organize recently accessed information. Naïve Bayes has been used by (Natuzzuhriyyah et al., 2021) to classify student satisfaction levels using RapidMiner with 76.92% accuracy, 100% precision, 57.14% of recall and 0.881 or close to 1 of AUC, so the resulting model is good. The same research conducted by (Yanti & Kriestanto, 2022) shows satisfied respondents of the testing data classification from respondent number R89 to R93 towards the online learning system during the Covid-19 pandemic and (Samuel & Dewi, 2019) the attributes used are content quality, relevanance, privacy, ease to operate, speed, visual appeal, online completeness, and customer service; shows the classification of determining user



satisfaction using the Naïve Bayes method gets the greatest accuracy value with training data testing. Other student satisfaction level research has been conducted (Faisal & Nurhayati, 2020) using K-Nearest Neighbor to get an accuracy of 98%, a recall of 86.67%, a precision of 100%, and an AUC of 0.75. The same research was conducted by (Diansyah, 2022) based on the test results has an accuracy rate of 94.12% with k = 5 as the optimal k value.

The difficulty in this research is collecting the data because measurement methods relying on self-reporting, such as questionnaires, may be subject to response biases and inaccurate reporting. Student's responses may be influenced by factors such as social desirability bias or mood at the time of response. Students may have varying criteria for assessing satisfaction, making establishing a standardized measurement approach difficult. Therefore, this research uses K-Nearest Neighbour which is hereafter abbreviated as K-NN and Naive Bayes to classify student satisfaction levels because of the simplicity yet efficiency and the ability to handle mixed data. K-NN and Naïve Bayes are well-established and widely used classification algorithms, and they have been successfully applied to various domains and have a strong presence in the literature. K-NN is a non-parametric instance-based algorithm that classifies data based on the similarity of its neighboring instances. Naïve Bayes, on the other hand, is a probabilistic algorithm that applies Bayes' theorem and assumes independence between features.

K-NN effectively captures local patterns and can adapt well to varying densities in the feature space, which is valuable for identifying similarities between student's satisfaction levels. It can handle numerical and categorical features, making it applicable to many student satisfaction factors. Naive Bayes is well-suited when the dependencies between features have a minimal impact on the classification performance. It can handle large datasets with high-dimensional feature spaces, making it scalable for analyzing various factors contributing to student satisfaction.

Additionally, by comparing the performance of both algorithms, the research can provide insights into their relative strengths and weaknesses for classifying student satisfaction levels in an online learning environment. This research is distinct from previous studies is that this research compares two classification algorithms, Naïve Bayes and K-NN. The dataset that is the basis for grouping is communication, student assessment, learning atmosphere, and material delivery. Another reason this research differs from previous research because is that it focuses on examining the effectiveness of these algorithms in classifying data related to communication, student assessment, learning atmosphere, and material delivery. By comparing the performance of both algorithms, we can gain insights into their respective strengths and limitations in handling this specific dataset.

Therefore, this research aims to find the best algorithm for classifying satisfaction levels and can be used as advice or consideration by related parties based on the analysis results that have been obtained. The analysis results obtained from the research can serve as a reference and consideration for decision-making processes, allowing stakeholders to make informed choices regarding the classification of student satisfaction levels. This information can guide the development and improvement of online learning programs, leading to enhanced student experiences and improved educational outcomes.

## II. RESEARCH METHOD

### A. Slovin Technique

The Slovin technique is used to determine the minimum sample size of a population, provided that the population is relatively large. The first thing that needs to be done is to set the confidence level or margin of error (%) of the facts or the significance level of error tolerance (0,..) that will occur. The margin of error is an indicator of the accuracy of an estimate. Typically, the "margin of error" that is often used is 5% or a confidence level of 0.95 (Mohr et al., 2022). The formula for determining the sample size according to Slovin, as in (1) below (W.-C. Yang et al., 2020) :

$$n = \frac{N}{1 + N (e)^2} \tag{1}$$

### B. Simple Random Sampling

The sample data is chosen randomly and purely by chance. Hence the quality of the sample is not affected since every member has an equal chance of being selected as the sample. This type of sampling is most suitable for highly homogeneous populations (Bhardwaj, 2019). Simple random sampling requires carefully defining the population from which the sample is drawn (Golzar, 2022).

### Hold-Out

The hold-out method randomly divides data into two separate sets: training and test sets. The data is divided multiple times; for each division, the host selects one predictor; then, the predictors gained by different divisions are combined (Maillard et al., 2021). Usually, about two-thirds of the data is distributed to the training set, and the rest one-third is distributed to the testing set. The training set is used to obtain a model. The model's accuracy is evaluated with the testing set. Data sharing can do with percentages such as 90:10, 50:50, 80:20, 70:30, and 75:25. (Awwalu et al., 2019).

### Data Collection Technique

This research uses five stages, as shown in Fig.1 below; the first stage is planning. At this stage, identification of problems occurring, especially the impact of Covid-19 on the learning process, in the form of an evaluation. Furthermore, determining the objectives that serve to clarify the framework of what is the target of this research. At this stage, researchers also look for sources or references relevant to the research methods, from scientific articles, books, proceedings, and so on, which will be used as research references. Then determine the limitations of the problem, which aims to make the scope of a problem or discussion to be carried out focused and stay consistent with the research.

The second is data collection. The data source in this study was collected through an online questionnaire. A questionnaire is one of the tools commonly used to collect information such as a form containing a series of questions filled in by respondents to provide the information researchers need for research (Taherdoost, 2021). The questionnaire was distributed to respondents via online media, namely Whatsapp because the author could distribute questionnaires on target to students who had participated in online learning. The data collection for this study was conducted over 2 months, specifically from October 8 to December 8, 2022. The target population was students from the Islamic State University of Sultan Syarif Kasim Riau who had experienced online learning. A closed online questionnaire comprising 13 questions was used to ensure a representative sample (Yanti & Kriestanto, 2022).

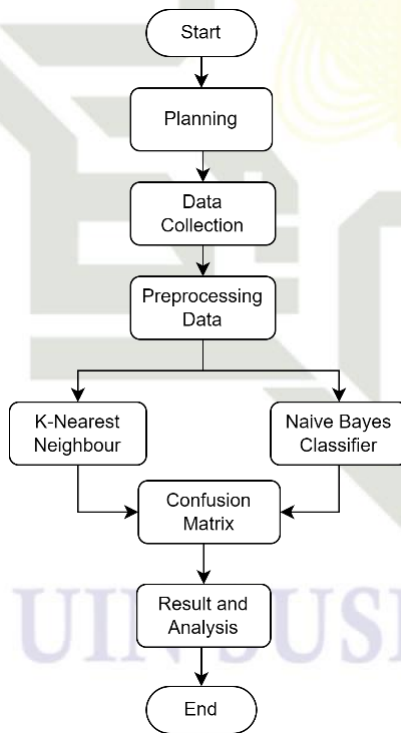


Figure 1 Research Method

The Slovin technique with 10% margin of error (Ali, 2019; Anderjovi et al., 2022);(Bimaruci et al., 2020) and simple random sampling was used to determine the appropriate sample size. According to the calculations, the minimum sample size required for this research was 100 data points. However, to

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improve the accuracy of the results, enhance sample representation, and mitigate potential unrepresentativeness, the researchers opted to utilize a larger sample size of 140 data points. As explained by (Spinde et al., 2021) and (S. T. Noor et al., 2021) in their paper, a larger dataset is needed to improve research results. By increasing the sample size beyond the minimum requirement, the study aimed to enhance the precision and reliability of the findings. This larger sample allows for more robust analysis and strengthens the generalizability of the results to the broader population of Islamic State University students who have experienced online learning. It is worth noting that by utilizing the Slovin technique and employing simple random sampling, the researchers ensured that each participant had an equal chance of being selected, minimizing potential bias and increasing the validity of the study's conclusions.

Once the data is collected, the next stage is pre-processing data following the stages in data mining. First, data cleaning is done to avoid incomplete data and prevent data duplication and then combines clean data into a data set. After this stage, the data is processed using K-NN and Naïve Bayes then the results of both algorithms are tested using Confusion Matrix. The last stage is results and analysis, here drawing conclusions and describing the results of observations and knowing how the classification results.

The questionnaire's research attributes were measured using a Likert scale. The surveyed participants were instructed through an instruction to indicate their level of agreement (from strongly disagree to strongly agree) with each question (item) on a metric scale. (Hassan, 2019). The research attributes are shown in Table 1, and the Likert scale used to measure the research attributes is shown in Table 2 below:

Table 1 Attribute and Value

No	Attribute	Value
1	Material Delivery (A)	1,2,3,4,5
2	Communication (B)	1,2,3,4,5
3	Student Assessment (C)	1,2,3,4,5
4	Learning Atmosphere (D)	1,2,3,4,5

Table 2 Rating Scale

Rating Scale	Value
Very Good	5
Good	4
Quite Good	3
Less Good	2
Not Good	1

After preprocessing, the data obtained is ready for classification, as shown in Table 3 below, based on the research dataset below, the second data is that students from Science and Technology faculty gave a score of 3 (quite good) to the attribute of material delivery, a score of 4 (good) for communication, a score of 2 (less good) or less for student assessment, and a score of 2 (less good) or less for learning atmosphere.

Table 3 Research Dataset

No	Faculty	A	B	C	D
R1	Agriculture and Animal Husbandry	2	4	2	3
R2	Science and Technology	3	4	2	2
R3	Science and Technology	3	4	3	3
R4	Science and Technology	3	3	3	4
R5	Education and Teacher Training	3	4	4	3
R6	Usul al-Din	3	3	3	3
R7	Science and Technology	3	4	3	3
R8	Sharia and Law	4	4	4	4
R9	Science and Technology	3	4	3	4
R10	Economics and Social Sciences	2	2	2	2
...	...	...	...	...	...
R139	Psychology	1	1	1	1
R140	Da'wa and Communication	3	3	2	3

## RESULTS AND DISCUSSION

### K-Nearest Neighbor (K-NN)

K-Nearest Neighbor is a query-triggered but improvised learning procedure. The algorithm is only performed when the test data is predicted, setting an appropriate k value and searching for the K nearest neighbors (Zhang & Li, 2021). Besides being easy to understand, the algorithm is also versatile, covering a wide range of applications. Apart from its simplicity, as a simple classifier that does not generate trained models but keeps or remembers training examples in exchange (Karam et al., 2022). To calculate the squared Euclidean distance using (2):

$$d(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \dots + (q_n - p_n)^2} \tag{2}$$

One hundred forty data were processed using K-NN, which had already passed the preprocessing stage. In this method, the K value aims to determine the number of nearest neighbors of the training set. The dataset is divided into 70% for the training set and 30% for the testing set (Vrigazova, 2021). Data processing is done using Python with various K-value experiments. The classification results of various K values are then tested with a confusion matrix, as shown in Fig. 2, Fig. 3, Fig. 4, and Fig. 5 below:

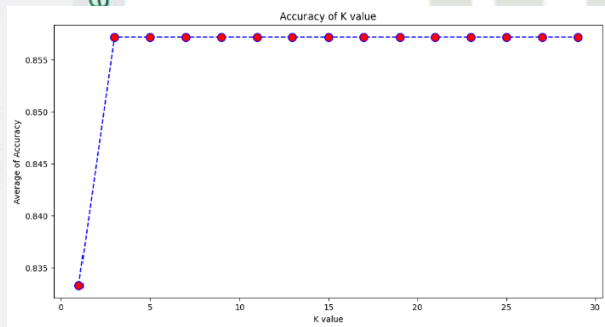


Figure 2 K-NN Confusion Matrix Accuracy

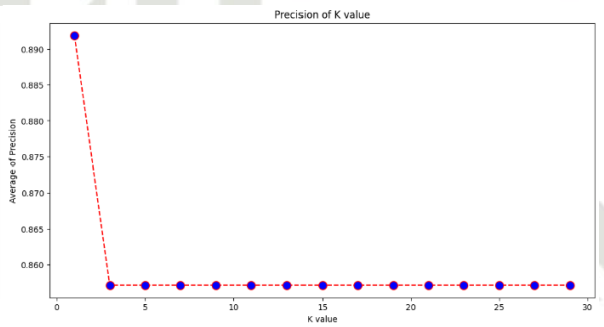


Figure 3 K-NN Confusion Matrix Precision

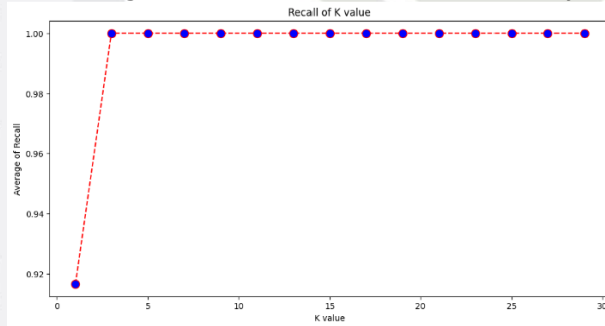


Figure 4 K-NN Confusion Matrix Recall

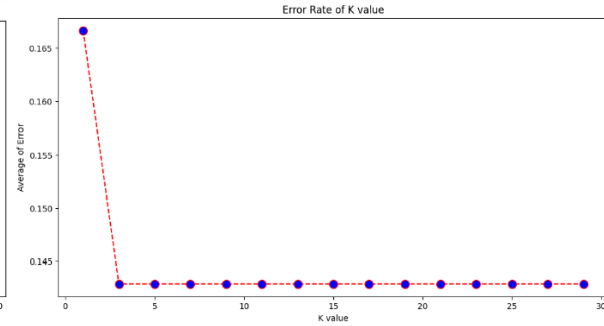


Figure 5 K-NN Confusion Matrix Error

As can be seen from the above four figures, starting from the value of K=3 and above, the graph begins to form a straight line on the diagram, even when the value of k is increased, indicating that the accuracy of the model no longer increases with a more significant number of nearest neighbors. This indicates that up to any value of K, the results will always be the same and form a straight line. In this case, K=3, which produces a straight line, is the optimal k value for the K-NN model.

### B. Naïve Bayes

Naïve Bayes is a probabilistic classifier that relies on the Bayes theorem and assumes feature independence for a particular class (Uddin & Ahmed, 2020). Naïve Bayes called the conditional independence assumption, assumes that all attributes are independent given the output class (Sari et al., 2019). To solve the problem using Naïve Bayes can be done with the following (3) (Patel & Parikh, 2020):

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \tag{3}$$



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Another classification algorithm used in this research is Naïve Bayes. It uses the same data as in the classification process with K-NN. Naïve Bayes has widely been adopted to predict results under uncertainty (F. J. Yang, 2018).

### Confusion Matrix

The confusion matrix is an easy and powerful tool to demonstrate the performance of a classifier and is easy to understand the results. The performance of any model or algorithm can be evaluated with the confusion matrix (Yun, 2021). The performance of a classification model can be measured by its accuracy (Gong, 2021). KNN effectively captures local patterns and can adapt well to varying densities in the feature space, which is valuable for identifying similarities between students' satisfaction levels. Naive Bayes is well-suited when the dependencies between features have a minimal impact on the classification performance. The K-NN confusion matrix shows that out of the total data points, 36 are classified as true positives, 0 as false negatives, 6 as false positives, and 0 as true negatives. The accuracy is calculated as 85%. The precision, which measures the proportion of correctly classified positive examples among the total predicted positive example, is also 85%. The recall, also known as sensitivity or true positive rate, measures the proportion of correctly classified positive examples among the true positive example, which is 99%.

Then, the Naïve Bayes confusion matrix shows that 34 data points are classified as true positives, 2 as false negatives, 6 as false positives, and 0 as true negatives. The accuracy is calculated as 80%. The precision, which indicates the accuracy of positive predictions, is 84%. The recall, which measures the model's ability to find all the positive instances, is 93%. The results of both classifications are then tested using the confusion matrix as shown in Fig. 6, and Fig. 7 below:

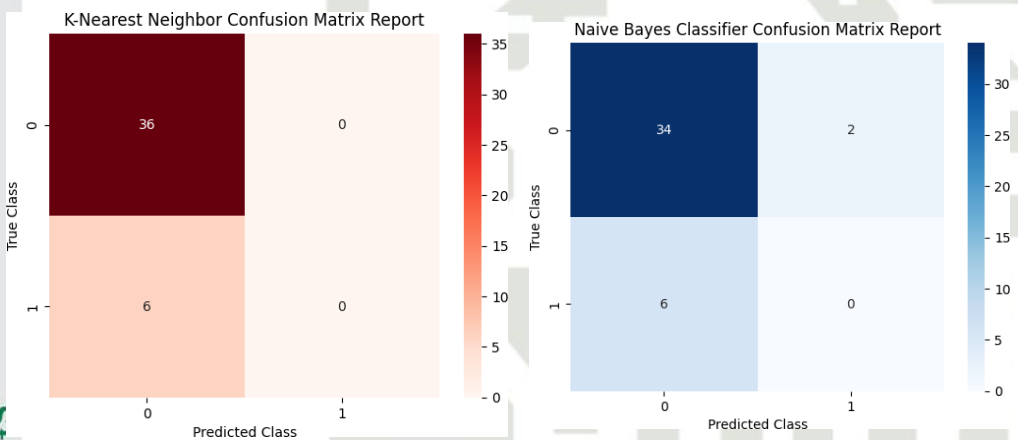


Figure 6 Confusion Matrix K-NN      Figure 7 Confusion Matrix Naïve Bayes

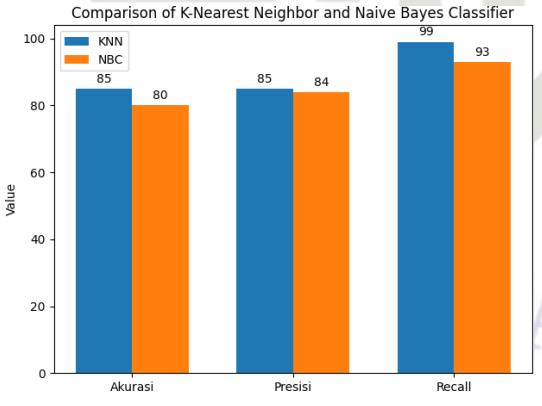


Figure 8 Comparison of both algorithms

Based on its higher accuracy and recall values, the results are that the K-NN algorithm may be more effective in classifying student satisfaction levels with online learning than the Naïve Bayes algorithm. However, the significance of these differences and the selection of the best model ultimately depend on the specific research question, the context of the study, and other relevant considerations.

## Discussion

While higher accuracy and recall values indicate that K-NN may perform better in this particular scenario, other factors should be considered. The assumption of independence made by the Naïve Bayes algorithm might not hold in all cases. If the features used for classification are not truly independent, it can lead to suboptimal performance. As a non-parametric algorithm, K-NN makes no strong assumptions about the underlying data distribution. Additionally, the interpretability of the model can be an essential consideration. Naïve Bayes provides precise probabilities and allows for interpretability, making understanding the factors contributing to the classification decisions easier. K-NN, on the other hand, does not provide such straightforward interpretability.

In conclusion, while the statement suggests that K-NN may be more effective in classifying student satisfaction levels with online learning based on higher accuracy and recall values, selecting the best model requires considering the specific research question, the context of the study, computational efficiency, assumptions made by the algorithms, dimensionality of the dataset, and interpretability requirements.

## IV. CONCLUSION

Based on the objectives of this research through the data analysis and processing results, the best classification algorithm to classify student satisfaction with online learning is K-NN. It shows that K-NN can produce more accurate results. Confusion Matrix is used to validate the classification results. It shows that the comparison of the accuracy of K-NN and Naïve Bayes is 86%: 80%, precision comparison 85%: 91%, and 100% recall comparison: 86%. Although Naïve Bayes has a higher precision value than K-NN, K-NN is superior in accuracy and recall. The perfect recall of K-NN indicates that the model can correctly classify all students who should belong to a particular category (e.g delighted students). It shows the reliability of the K-NN in recognizing positive cases.

For further exploration research there are numerous other classification algorithms that could be considered. Algorithms such as Decision Trees, Random Forests, Support Vector Machines, or Neural Networks may offer alternative approaches to classifying student satisfaction. Implement different cross-validation techniques, such as k-fold cross-validation or stratified cross-validation, to assess the generalization performance of the classification model. And supplement the quantitative analysis with qualitative research methods, such as interviews or surveys, to gain a deeper understanding of the reasons behind student satisfaction or dissatisfaction in online learning.

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## LAMPIRAN A

### SURAT HIMBAUAN REVISI

6/8/23, 10:52 PM

Email Universitas Islam Negeri Sultan Syarif Kasim Riau - [JITE] Editor Decision



HILDA MUTIARA NASUTION &lt;11950324870@students.uin-suska.ac.id&gt;

#### [JITE] Editor Decision

1 pesan

Muhathir Muhathir &lt;muhathir@staff.uma.ac.id&gt;

5 Juni 2023 pukul 15.07

Kepada: Hilda Mutiara Nasution &lt;11950324870@students.uin-suska.ac.id&gt;

Hilda Mutiara Nasution (Author):

We have reached a decision regarding your submission to JOURNAL OF INFORMATICS AND TELECOMMUNICATION ENGINEERING, "Comparison of Student Satisfaction Levels Classification on Online Learning Using K-NN and Naïve Bayes".

Our decision is: **Revisions Required by due date june 12, 2023**

Editor:

**please highlight every revision you make, red for reviewer B and green for reviewer C**

-----  
Reviewer B:

Recommendation: Revisions Required  
-----

Comment on the TITLE (it should consist of: the METHOD, AIMS, and OBJECTS)

OK.

Comment on ABSTRACT (It should consist of Problem, Aims, Method, Results, Conclusion, and Implication)

OK.

Comments on INTRODUCTION (It should be consist of: background knowledge, state of the art method, research gap, AIMS, and proposed method)

What is the importance of measuring student satisfaction levels in online learning? What are the challenges faced in objectively measuring student satisfaction and why were classification methods such as K-NN and Naïve Bayes chosen for this study?

Comments on MATERIALS and METHOD (it should consist of: Architecture research, dataset, data collection & measurement, and data analysis)

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Does this study aim to compare the performance of K-NN and Naïve Bayes in classifying student satisfaction levels, or does this research try to identify the features that most influence student satisfaction levels?

Comments on RESULTS (it should consist of: the main finding in Table or Graphics, results should not a raw data)

Is there a significant difference between the performance of K-NN and Naïve Bayes in classifying student satisfaction levels?

Comment on DISCUSSION (It should consist of interpretation of the result, comparison with other studies, the limitation of the study, and implication)

Are there features that are more influential in identifying the level of student satisfaction? Include relevant statistics or evaluation results to support this finding.

Comments on CONCLUSION (it should consist of: restate the AIMS, main findings, and future works)

Provide conclusions regarding this research and its relevance in developing evaluations of student satisfaction in online learning.

Comments on REFERENCES (it should be up to date, less self citation (10%), completeness of the references)

OK.

Other comments (a. are the figure and table already cited in the text?, b. are the English language adequate?, c. are the article structure well manage?)

Enough.

The overall SCORE for this article (0-100)

80

Reviewer C:  
Recommendation: Revisions Required

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UIN SUSKA RIAU



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6/8/23, 10:52 PM

Email Universitas Islam Negeri Sultan Syarif Kasim Riau - [JITE] Editor Decision

Comment on the TITLE (it should consist of: the METHOD, AIMS, and OBJECTS)

The title includes the research method (K-NN and Naive Bayes) as well as the research subject (student satisfaction levels in online learning). However, the research objective is not explicitly mentioned in the title. To include the research objective in the title, you can add phrases like "A Comparative Study" or "An Evaluation of" at the beginning of the title.

Comment on ABSTRACT (It should consist of Problem, Aims, Method, Results, Conclusion, and Implication)

Your abstract generally provides a good summary of your research. However, I have some suggestions for further improvement:

**Specificity:** You should be more specific in the first few sentences. You are talking about how the Covid-19 pandemic has affected teaching and learning activities, but you should clarify which regions or countries you are referring to.

**Clarity:** Make sure that the main points of your research are clear. You're saying you want to measure the level of student satisfaction and find out the best algorithm for classifying the level of student satisfaction, but it would be better to explain why you are focusing on these specific aspects.

**Language:** Some sentences could be reworded for clarity and brevity. For example, the sentence "This new learning culture can only be applied effectively after it requires adaptation" could be rephrased as "This new learning culture requires adaptation for effective implementation".

It would be better if the objectives of the research are stated explicitly and in more detail.

Comments on INTRODUCTION (It should be consist of: background knowledge, state of the art method, research gap, AIMS, and proposed method)

In the given introduction, several areas can be improved for clarity and completeness. The following points summarize the potential shortcomings:

**Background Knowledge:** While the text provides a good overview of the impact of the COVID-19 pandemic on education and the need for online learning, it doesn't delve into the specifics of student satisfaction in an online learning environment. It would be beneficial to present more information on this topic, which could provide a stronger foundation for the research.

**State of the Art Method:** The introduction briefly mentions previous studies that used data mining techniques, specifically Naive Bayes and K-Nearest Neighbor, to classify student satisfaction levels. However, it would help to provide a more detailed explanation of these methods, their outcomes, and their limitations.

**Research Gap:** The introduction identifies a research gap but does so without much emphasis or detail. It would be more compelling if the research gap were clearly highlighted and explained in terms of why the existing methods might not be sufficient or what aspects of the problem have not been adequately addressed in the current literature.

**AIMS:** While the introduction does state the aim of the study, it does so only briefly and at the very end of the section. It might be more effective to articulate the research objectives in a

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6/8/23, 10:52 PM

Email Universitas Islam Negeri Sultan Syarif Kasim Riau - [JITE] Editor Decision

clearer and more detailed manner, and possibly earlier in the introduction, so that readers know the purpose of the study from the start.

Proposed Method: The introduction does not adequately explain the methods proposed for the study. It mentions the use of two algorithms for classifying student satisfaction levels, but it does not go into detail about how these methods will be applied and what makes them suitable for this particular study.

Comments on MATERIALS and METHOD (it should consist of: Architecture research, dataset, data collection & measurement, and data analysis)

Detailed Explanation: In certain sections, your explanations may need to be more detailed, such as the process of collecting data through an online questionnaire. You should elaborate on how the questions were formulated and how responses were collected and analyzed.

Research Architecture Design: You haven't explained the research architecture in detail. This should include an explanation of how each step of the research is connected and how they contribute to achieving the research objectives.

Dataset Details: You haven't outlined the details of your dataset. You need to provide more information about the dataset you used, such as the total number of entries, the type of data (numeric or categorical), the number of features, and so on.

Model Validation: You haven't explained how you will validate your models. For instance, you don't explain how you will use the confusion matrix to measure the effectiveness of your models.

Comments on RESULTS (it should consist of: the main finding in Table or Graphics, results should not a raw data)

Interpret the Results: You should also interpret the results in the context of your research question. What do these results mean in terms of student satisfaction with online learning? Does one model perform significantly better than the other?

Comment on DISCUSSION (It should consist of interpretation of the result, comparison with other studies, the limitation of the study, and implication)

Interpretation of Results: While you have explained the results of your tests, it may be beneficial to provide more interpretation and discussion about what these results mean for your research. For instance, what does the optimal K-value for the K-NN model imply about your dataset and model? How do the accuracy, precision, and recall of your models influence the outcomes of your research?

Comparison with Other Studies: You might want to compare your findings with those of other similar studies. Do your findings align with or contradict previous research? If there's a difference, what could be the potential reasons for that? Comparing your results with others can strengthen the validity of your research and provide a wider context for your findings.

<https://mail.google.com/mail/u/0/?ik=f04454d2e9&view=pt&search=all&permthid=thread-f:1767849319767045213&simpl=msg-f:17678493197670...> 4/5

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6/8/23, 10:52 PM

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Comments on CONCLUSION (it should consist of: restate the AIMS, main findings, and future works)

In the conclusion, it has not yet provided a better understanding of what you have achieved through your research (research objectives). It has not yet mentioned some potential directions for future research based on your results and findings, which is also important. What hasn't been addressed in this study? What can be explored further?

Comments on REFERENCES (it should be up to date, less self citation (10%), completeness of the references)

This research is indeed up to date, as it is based on current knowledge about online learning. However, improvements in the completeness of the references are necessary.

Other comments (a. are the figure and table already cited in the text?, b. are the English language adequate?, c. are the article structure well manage?)

There are several grammatical issues that need to be corrected. The article is well-structured, but the sub-structure for the methods, results, and discussion sections needs to be enhanced because it doesn't sufficiently inform readers about the methods used, the results obtained, and the discussion related to those results.

The overall SCORE for this article (0-100)


76

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UIN SUSKA RIAU

## LAMPIRAN B

### BUKTI KEPUTUSAN EDITOR

6/19/23, 7:29 AM

Email Universitas Islam Negeri Sultan Syarif Kasim Riau - [JITE] Editor Decision



HILDA MUTIARA NASUTION <11950324870@students.uin-suska.ac.id>

#### [JITE] Editor Decision

1 pesan

Jurnal Teknik Informasi Dan Telekomunikasj UMA <jite@uma.ac.id>  
Kepada: 11950324870@students.uin-suska.ac.id

7 Juni 2023 pukul 11.16

Hilda Mutiara Nasution (Author):

We have reached a decision regarding your submission to JOURNAL OF INFORMATICS AND TELECOMMUNICATION ENGINEERING, "Comparison of Student Satisfaction Levels Classification on Online Learning Using K-NN and Naive Bayes".

Our decision is: **Accepted with minor Revisions, due date june 12, 2023**

+++++





## LAMPIRAN B

### DATASET PENELITIAN

Tabel B.1. Dataset Penelitian

No	Fakultas	A	B	C	D	Hasil
R1	Pertanian dan Peternakan	2	4	2	3	Tidak Puas
R2	Sains dan Teknologi	3	4	2	2	Puas
R3	Sains dan Teknologi	3	4	3	3	Puas
R4	Sains dan Teknologi	3	3	3	4	Puas
R5	Tarbiyah dan Keguruan	3	4	4	3	Tidak Puas
R6	Ushuluddin	3	3	3	3	Tidak Puas
R7	Sains dan Teknologi	3	4	3	3	Puas
R8	Syariah dan Ilmu Hukum	4	4	4	4	Puas
R9	Sains dan Teknologi	3	4	3	4	Puas
R10	Sains dan Teknologi	4	4	2	3	Tidak Puas
R11	Sains dan Teknologi	3	3	2	4	Tidak Puas
R12	Sains dan Teknologi	3	3	2	3	Tidak Puas
R13	Sains dan Teknologi	4	5	1	3	Puas
R14	Sains dan Teknologi	4	4	1	4	Puas
R15	Sains dan Teknologi	3	4	2	4	Puas
R16	Sains dan Teknologi	3	3	4	3	Puas
R17	Tarbiyah dan Keguruan	4	4	4	4	Puas
R18	Sains dan Teknologi	3	4	4	3	Puas
R19	Syariah dan Ilmu Hukum	2	3	5	3	Tidak Puas
R20	Sains dan Teknologi	3	3	3	3	Puas
R21	Sains dan Teknologi	3	3	3	4	Puas
R22	Tarbiyah dan Keguruan	3	4	2	3	Puas
R23	Sains dan Teknologi	3	4	2	4	Puas
R24	Sains dan Teknologi	3	3	2	3	Puas
R25	Sains dan Teknologi	3	4	4	2	Puas
R26	Pertanian dan Peternakan	3	5	1	4	Puas
R27	Ekonomi dan Ilmu Sosial	3	3	3	3	Puas
R28	Tarbiyah dan Keguruan	4	4	1	4	Puas
R29	Sains dan Teknologi	3	3	3	3	Puas
R30	Syariah dan Ilmu Hukum	4	3	2	3	Puas

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No	Fakultas	A	B	C	D	Hasil
R31	Sains dan Teknologi	3	4	2	3	Tidak Puas
R32	Sains dan Teknologi	3	3	3	3	Tidak Puas
R33	Sains dan Teknologi	3	5	2	3	Tidak Puas
R34	Sains dan Teknologi	3	4	2	4	Tidak Puas
R35	Sains dan Teknologi	3	4	3	4	Puas
R36	Pertanian dan Peternakan	3	4	3	4	Puas
R37	Sains dan Teknologi	3	3	4	3	Puas
R38	Tarbiyah dan Keguruan	4	3	3	3	Puas
R39	Tarbiyah dan Keguruan	4	5	2	3	Puas
R40	Sains dan Teknologi	4	3	3	3	Puas
R41	Pertanian dan Peternakan	3	4	2	3	Puas
R42	Tarbiyah dan Keguruan	3	4	2	4	Tidak Puas
R43	Pertanian dan Peternakan	2	3	2	3	Puas
R44	Tarbiyah dan Keguruan	2	3	3	1	Puas
R45	Ekonomi dan Ilmu Sosial	4	4	3	5	Puas
R46	Sains dan Teknologi	3	3	3	4	Puas
R47	Tarbiyah dan Keguruan	3	4	2	3	Puas
R48	Dakwah dan Komunikasi	2	4	4	3	Puas
R49	Pertanian dan Peternakan	3	3	3	3	Puas
R50	Pertanian dan Peternakan	3	4	2	3	Puas
R51	Syariah dan Ilmu Hukum	2	2	2	2	Tidak Puas
R52	Sains dan Teknologi	5	2	5	4	Puas
R53	Sains dan Teknologi	3	5	1	3	Puas
R54	Sains dan Teknologi	3	3	3	3	Puas
R55	Sains dan Teknologi	3	3	4	4	Puas
R56	Sains dan Teknologi	3	3	3	3	Puas
R57	Dakwah dan Komunikasi	4	3	4	3	Puas
R58	Pertanian dan Peternakan	4	4	3	3	Puas
R59	Sains dan Teknologi	2	4	4	3	Puas
R60	Ekonomi dan Ilmu Sosial	1	4	4	2	Tidak Puas
R61	Sains dan Teknologi	2	4	3	3	Puas
R62	Pertanian dan Peternakan	3	3	4	3	Puas
R63	Sains dan Teknologi	3	3	2	4	Puas
R64	Sains dan Teknologi	3	3	3	4	Puas

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Table B.1 continued from previous page

No	Fakultas	A	B	C	D	Hasil
R65	Sains dan Teknologi	4	4	2	4	Puas
R66	Sains dan Teknologi	4	4	2	4	Puas
R67	Sains dan Teknologi	3	3	3	2	Tidak Puas
R68	Sains dan Teknologi	4	3	3	2	Puas
R69	Sains dan Teknologi	3	3	3	3	Puas
R70	Sains dan Teknologi	2	2	2	4	Puas
R71	Sains dan Teknologi	3	4	3	3	Tidak Puas
R72	Sains dan Teknologi	3	3	2	3	Tidak Puas
R73	Sains dan Teknologi	4	4	4	3	Tidak Puas
R74	Pertanian dan Peternakan	3	3	3	3	Puas
R75	Sains dan Teknologi	4	3	2	3	Puas
R76	Sains dan Teknologi	5	5	5	3	Puas
R77	Sains dan Teknologi	5	3	4	3	Puas
R78	Sains dan Teknologi	4	4	4	4	Puas
R79	Dakwah dan Komunikasi	3	3	2	3	Tidak Puas
R80	Sains dan Teknologi	4	4	2	4	Puas
R81	Tarbiyah dan Keguruan	4	4	2	4	Puas
R82	Sains dan Teknologi	3	3	2	3	Puas
R83	Sains dan Teknologi	4	3	3	5	Puas
R84	Sains dan Teknologi	3	3	3	3	Puas
R85	Sains dan Teknologi	3	3	3	3	Puas
R86	Sains dan Teknologi	3	4	3	3	Puas
R87	Sains dan Teknologi	3	4	2	3	Puas
R88	Sains dan Teknologi	3	3	2	3	Puas
R89	Sains dan Teknologi	3	4	2	4	Tidak Puas
R90	Sains dan Teknologi	3	4	1	4	Puas
R91	Sains dan Teknologi	4	4	2	4	Puas
R92	Sains dan Teknologi	3	4	2	3	Puas
R93	Syariah dan Ilmu Hukum	3	4	2	1	Puas
R94	Sains dan Teknologi	3	4	2	3	Puas
R95	Sains dan Teknologi	2	4	4	2	Puas
R96	Sains dan Teknologi	3	3	2	3	Puas
R97	Sains dan Teknologi	3	4	2	3	Puas
R98	Tarbiyah dan Keguruan	4	5	1	4	Puas

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Table B.1 continued from previous page

No	Fakultas	A	B	C	D	Hasil
R99	Sains dan Teknologi	4	4	4	4	Puas
R100	Tarbiyah dan Keguruan	3	3	2	3	Puas
R101	Syariah dan Ilmu Hukum	4	4	4	4	Puas
R102	Sains dan Teknologi	3	4	2	4	Puas
R103	Ushuluddin	2	5	2	2	Tidak Puas
R104	Tarbiyah dan Keguruan	2	3	3	3	Tidak Puas
R105	Sains dan Teknologi	3	5	2	3	Puas
R106	Sains dan Teknologi	3	5	2	4	Puas
R107	Tarbiyah dan Keguruan	3	3	3	3	Puas
R108	Tarbiyah dan Keguruan	2	3	4	3	Puas
R109	Syariah dan Ilmu Hukum	4	5	1	1	Puas
R110	Dakwah dan Komunikasi	2	2	2	2	Puas
R111	Tarbiyah dan Keguruan	2	2	1	3	Puas
R112	Tarbiyah dan Keguruan	3	4	2	4	Puas
R113	Ushuluddin	4	3	2	5	Puas
R114	Ushuluddin	4	5	3	4	Puas
R115	Tarbiyah dan Keguruan	3	4	3	3	Puas
R116	Ekonomi dan Ilmu Sosial	2	4	2	2	Tidak Puas
R117	Ekonomi dan Ilmu Sosial	3	4	4	3	Puas
R118	Ekonomi dan Ilmu Sosial	2	2	2	2	Puas
R119	Psikologi	3	3	3	3	Puas
R120	Psikologi	3	3	3	3	Puas
R121	Psikologi	3	4	4	2	Puas
R122	Tarbiyah dan Keguruan	4	3	4	4	Puas
R123	Syariah dan Ilmu Hukum	4	4	4	5	Tidak Puas
R124	Syariah dan Ilmu Hukum	3	2	1	1	Tidak Puas
R125	Tarbiyah dan Keguruan	3	4	4	4	Puas
R126	Ushuluddin	2	4	2	3	Puas
R127	Psikologi	1	1	1	1	Tidak Puas
R128	Psikologi	3	4	4	3	Puas
R129	Psikologi	3	3	4	4	Tidak Puas
R130	Psikologi	3	3	3	3	Tidak Puas
R131	Ekonomi dan Ilmu Sosial	4	4	4	5	Puas
R132	Ekonomi dan Ilmu Sosial	2	3	4	3	Puas

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Table B.1 continued from previous page

No	Fakultas	A	B	C	D	Hasil
R133	Ekonomi dan Ilmu Sosial	4	4	4	3	Puas
R134	Syariah dan Ilmu Hukum	3	3	3	5	Puas
R135	Tarbiyah dan Keguruan	3	5	4	4	Puas
R136	Ushuluddin	4	4	5	5	Puas
R137	Ushuluddin	2	3	2	2	Tidak Puas
R138	Tarbiyah dan Keguruan	2	3	3	3	Puas
R139	Tarbiyah dan Keguruan	3	4	4	3	Puas
R140	Tarbiyah dan Keguruan	3	3	3	3	Puas

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## LAMPIRAN C KUESIONER PENELITIAN

*Assalamualaikum wr.wb*

Dengan hormat,

Responden yang terhormat, perkenalkan saya Hilda Mutiara Nasution mahasiswi jurusan Sistem Informasi Universitas Islam Negeri Sultan Syarif Kasim Riau. Saat ini saya sedang mengadakan penelitian tugas akhir saya mengenai ”*Perbandingan Klasifikasi Tingkat Kepuasan Mahasiswa Terhadap Pembelajaran Daring Menggunakan K-NN dan Naive Bayes*”

Penelitian ini menggunakan kuesioner sebagai alat pengumpulan data primer. Oleh karena itu, saya mohon bantuan teman-teman untuk berkenan meluangkan waktu mengisi/memberikan jawaban atas beberapa pertanyaan terkait dengan penelitian ini. Apapun yang teman-teman jawab di kuesioner ini tidak ada jawaban yang salah, namun saya mohon agar teman-teman menjawab semua pertanyaan secara lengkap sesuai ketentuan. Atas perhatian dan waktu yang teman-teman berikan untuk mengisi/memberikan jawaban, Saya ucapkan terima kasih.

Hormat saya,

**Hilda Mutiara Nasution**

Note:

- Semua informasi yang dicantumkan dijaga kerahasiannya.
- Penelitian ini digunakan untuk tujuan ilmiah.

### C.1 IDENTITAS RESPONDEN

Nama : .....

E-mail : .....

Jurusan : .....

Semester : .....

### C.2 PETUNJUK PENGISIAN

1. Kuesioner ini hanya digunakan untuk kepentingan ilmiah dan pengembangan ilmu pengetahuan. Semua jawaban akan ditangani secara rahasia oleh peneliti.
2. Setiap pernyataan telah disediakan lima buah jawaban. Pilihlah salah satu jawaban yang memenuhi persepsi anda dengan cara melingkari angka pada



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kolom jawaban.

3. Keterangan kolom pengisian:

- 5 = Sangat Puas
- 4 = Puas
- 3 = Cukup Puas
- 2 = Kurang Puas
- 1 = Tidak Puas

**Tabel C.2.** Daftar pertanyaan kuesioner

No	Pertanyaan	SP (5)	P (4)	CP (3)	KP (2)	TP (1)
1	Bagaimana komunikasi, sikap pengajar dalam menerima pendapat atau saran dan kritik dari mahasiswa, serta memperoleh kemudahan dalam menghubungi dosen untuk bertanya mengenai materi dan pembelajaran daring yang terjadi selama melaksanakan perkuliahan secara daring selama pandemi Covid-19					
2	Bagaimana cara penilaian terhadap mahasiswa, apakah dosen memberikan nilai yang sesuai dengan kemampuan mahasiswa tersebut selama perkuliahan daring di masa Pandemi Covid-19					
3	Menurut anda, bagaimana cara sistem perkuliahan membangun suasana belajar pada saat pembelajaran daring selama pandemi Covid-19 kemarin?					
4	Apakah anda memahami materi yang diajarkan selama daring? Bagaimana penyampaian materi perkuliahan selama pembelajaran daring di masa pandemi Covid-19?					

Table C.2 continued from previous page

No	Pertanyaan	SP (5)	P (4)	CP (3)	KP (2)	TP (1)
5	Apakah anda merasa puas dengan sisem pembelajaran daring selama pandemi Covid-19 kemarin?					



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## DAFTAR RIWAYAT HIDUP



Penulis lahir di Kota Padangsidimpuan pada 21 Mei 2001. Penulis merupakan anak ke-2 dari 5 bersaudara dari pasangan Bapak Mukhtar Yahya Nasution dan Ibu Nenny Elita Lubis yang bernama Hilda Mutiara Nasution. Penulis bertempat tinggal di Kota Padangsidimpuan, Kecamatan Padangsidimpuan Utara, Sumatera Utara. Penulis berkebangsaan Indonesia dan beragama Islam. Penulis menempuh pendidikan yang diawali dari pendidikan taman kanak-kanak TK Pertiwi tahun 2006-2007, selanjutnya penulis melanjutkan pendidikan Sekolah Dasar di SDN 15 Padangsidimpuan pada 2007 dan lulus pada tahun 2013. Setelah menempuh pendidikan Sekolah Dasar, penulis melanjutkan pendidikan di Sekolah Menengah Pertama di SMPN 1 Padangsidimpuan pada tahun 2013 dan lulus pada tahun 2016, dan melanjutkan Sekolah Menengah Atas di SMAN 1 Padangsidimpuan pada tahun 2016 dan lulus pada tahun 2019. Tahun 2019 penulis melanjutkan pendidikan Strata Satu (S1) di Universitas Islam Negeri Sultan Syarif Kasim Riau, tepatnya Fakultas Sains dan Teknologi Jurusan Sistem Informasi. Selama masa perkuliahan, penulis bergabung dalam organisasi kampus yaitu *Puzzle Research Data Technology* (Pre-datech). Untuk menjalin komunikasi yang baik dengan penulis baik dari dalam kampus maupun luar kampus dapat menghubungi kontak melalui email penulis [hildamutiara12@gmail.com](mailto:hildamutiara12@gmail.com)

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