



# Increasing the Effectiveness of Higher Education Academic Services Through the Implementation of the Chatbot Platform Using the SVM Machine Learning Algorithm

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## ABSTRAK

Teknologi dan digitalisasi telah diadopsi oleh bidang pendidikan. Untuk menciptakan teknologi tepat guna yang mampu meningkatkan efektivitas dan efisiensi dari proses yang ada di pendidikan khususnya perguruan tinggi maka diperlukan inovasi – inovasi yang mampu memberikan value pada perguruan tinggi. Perlu dukungan yang tepat untuk meraih value dalam pelayanan akademik sebagai jantung perguruan tinggi. Namun, masih banyak perguruan tinggi yang belum dapat memberikan pelayanan yang maksimal. Adapun tujuan dari penelitian ini adalah untuk membuat model chatbot penunjang pelayanan akademik yang efektif untuk perguruan tinggi. Penelitian ini tergolong kedalam jenis penelitian design science research (DSR). Prosedur dari penelitian dilakukan melalui proses pengumpulan data, pengkategorian data, pembuatan model chatbot, evaluasi model dan implementasi model. Pengumpulan data dilakukan dengan cara mengundang para narasumber melalui focus group discussion (FGD) dengan kriteria adalah calon mahasiswa, mahasiswa, dan masyarakat yang memiliki kepentingan terhadap pelayanan akademik di perguruan tinggi. Para narasumber diminta mengajukan pertanyaan terkait pelayanan akademik yang dibutuhkan. Berdasarkan data yang didapat ada 257 pertanyaan terkait dengan pelayanan akademik. Pengkategorian layanan merupakan proses klasifikasi pertanyaan berdasarkan fungsi dari divisi atau departemen yang ada di perguruan tinggi. Berdasarkan hasil pengumpulan data dan pengkategorian layanan, selanjutnya dilakukan pembuatan model chatbot dan dilanjutkan dengan evaluasi model serta implementasi model. Hasil analisis penelitian menunjukkan bahwa model chatbot pengelola akademik yang menggunakan algoritma SVM mampu mengklasifikasikan pertanyaan yang diajukan melalui chatbot dengan akurasi 57% berkinerja mendukung layanan akademik perguruan tinggi.

## ABSTRACT

The education sector has adopted technology and digitization. To create appropriate technology that can increase the effectiveness and efficiency of existing processes in education, especially higher education, innovations are needed that can provide value to tertiary institutions. The right support is needed to achieve value in academic services as the heart of higher education. However, many universities still have not been able to provide maximum service. This research aims to create a chatbot model to support effective academic services for tertiary institutions. This research belongs to the type of research design science research (DSR). The research procedures were carried out by collecting data, categorizing data, creating chatbot models, model evaluation, and model implementation. Data was collected by inviting resource persons through focus group discussions (FGD), with the criteria being prospective students, university students, and the public interested in academic services in tertiary institutions. The resource persons were asked questions about the academic services needed. Based on the data obtained, there were 257 questions related to academic services. Service categorization is the process of classifying questions based on the functions of divisions or departments in tertiary institutions. Based on the data collection and service categorization results, a chatbot model is created, followed by model evaluation and implementation. The research analysis results show that the academic management chatbot model that uses the SVM

algorithm can classify questions asked through chatbots with an accuracy of 57%, performing to support higher education academic services.

## 1. INTRODUCTION

Academic services are services provided by educational institutions to students and their members in the form of convenience in the learning process, accuracy and speed of information, hospitality, and other skills (Azkiyah et al., 2020; Mildawati, 2021). The quality of an educational service (service quality) can be identified through students' perceptions and responses to the service obtained during academic activities (Azkiyah et al., 2020; Prahesti et al., 2021). If the perceived quality of academic service equals or exceeds the expected service quality, the service can be considered high quality (Septiani et al., 2020; Susetyo et al., 2022). In this case, academic services are not only limited to services regarding education but can also be in the form of information services and other non-academic services (Marlius & Ananda, 2020; Widiastuti et al., 2022). Five main aspects determine the quality of academic services, including responsiveness (responsiveness of an institution to student wishes, as well as the ability shown by the institution to help students both academically and non-academic), assurance (assurance of knowledge, as well as attitudes and behavior shown by agency employees in providing academic services), reliability (the ability of academic staff to provide appropriate, accurate and reliable services to students), empathy (a caring attitude shown by giving individual personal attention from students such as remembering student names), and tangibles (proof physical aspects of service quality such as physical facilities, equipment and means of communication for students) (Akhyar & Sumartono, 2023; Prahesti et al., 2021; Widawati & Siswohadi, 2020). The better the academic services an institution provides, the better the institution's quality in the eyes of the surrounding community.

The current phenomenon in the field shows that academic services are increasingly developing rapidly, so every institution is competing to create services that facilitate the educational process (Ardiansyah et al., 2023; Guntoro et al., 2020). In addition, the development of information that is getting faster requires every component of educational institutions to be able to provide fast information to students, where if there is a delay in service, it will have an impact on the learning process received (Herfian & Adriansyah, 2021; Nugraha & Sebastian, 2021). One of the academic service platforms that educational institutions widely use is chatbots. Chatbot is a computer program designed to create an interactive communication process between the user and the system via text, sound, and visuals (Hikmah et al., 2022; Zulkarnain et al., 2020). Chatbots can act as automatic conversation agents who can interact and communicate using human language, making it easier for individuals to obtain information anywhere and anytime (Cannavaro, 2023; Sarosa et al., 2020). In education, Chabot can provide various information services for students. The implementation of the chatbot platform can be carried out using the SVM machine learning algorithm, where the use of machine learning in the education sector has boosted the quality of the educational process, which can increase the potential for quality education (Supriyanto & Taufik, 2023).

The development of digitization in education is supported by machine learning and deep learning, where artificial intelligence and machine learning technologies have supported pre-medical education, resulting in professional staff (Kolachalama, 2022; Munir et al., 2022). The use of machine learning in education can help stakeholders in the process of accelerating academic performance (Kanetaki et al., 2022; Yağcı, 2022). Many types of machine learning algorithms can be used to support the process of digitizing technology in education, such as Naïve Bayes, ID3, C4.5, SVM, and Neural Networks that can support the process of predicting student retention (Pallathadka et al., 2023; Trivedi, 2022). In addition, there is also the K-nearest neighbors (KNN) algorithm which can support the student's academic evaluation process (Lezhnina & Kismihók, 2022; Okoye et al., 2022). The application of Chabot with machine learning has the potential to have an impact on increasing teaching and learning promotion, where higher education institutions, in carrying out their business processes, require a support system that can provide effective and efficient services and can increase customer satisfaction, namely students, lecturers, and other involved stakeholders. To provide the best service, providing fast and precise information is one indicator that needs to be met. Chatbot development is a machine capable of being one of the right strategies to improve service, reduce operational costs, and support interactive services (Adamopoulou & Moussiades, 2020; Almstaqim & Toscani, 2022; Eren, 2021).

Several previous studies have revealed that chatbots can help improve the quality of education through maximum service (Zulrahman et al., 2023). Chatbots can support smart services in smart libraries and can improve the performance of the new student admissions process (Amrullah et al., 2022). The results of other studies reveal that chatbot applications can improve the academic service process (Sugiono, 2022). Based on some of these research results, chatbot applications are feasible for improving

academic service processes and educational performance. In previous studies, no studies specifically discussed increasing the effectiveness of higher education academic services by implementing chatbot platforms using the SVM machine learning algorithm. So this research is focused on this study to create a chatbot model to support effective academic services for tertiary institutions.

## 2. METHOD

This research is a Design Science Research (DSR) study. The business process of academic services at tertiary institutions includes admitting new students to graduation and tracer study activities. This activity certainly involves a lot of human resources who must be able to manage services 24/7, non-stop. Therefore, to develop a chatbot that can manage academic services optimally, it is necessary to define the process from start to finish. The procedures for developing and implementing the chatbot model can be seen in Figure 1.

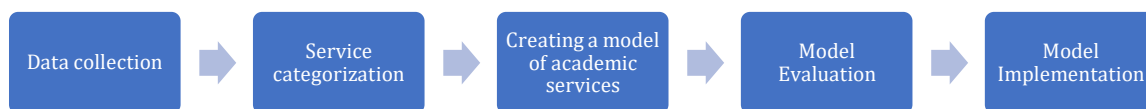


Figure 1. Research Procedure

Data was collected by inviting resource persons through focus group discussions (FGD), with the criteria being prospective students, university students, and the public interested in academic services in tertiary institutions. The resource persons were asked questions about the academic services needed. Based on the data obtained, there were 257 questions related to academic services. Service categorization is the process of classifying questions based on the functions of divisions or departments in tertiary institutions. Based on the data collection and service categorization results, a chatbot model is created, followed by model evaluation and implementation.

## 3. RESULT AND DISCUSSION

### Result

The stages of data collection resulted in 257 data questions related to academic services in tertiary institutions, including those related to the use of academic applications, academic bureaucracy, and other related services. The sample results from data collection can be seen in Figure 2. To create a chatbot engine that predicts the question's intent, the chatbot must be able to classify the question. Therefore a list of 257 questions is classified based on the functionality of the academic service, so the classification is found as shown in Figure 3. Based on Figure 3, questions related to Student Service 92, Academic 90, Marketing 24, ICT 20, Financial Service 16, Internship 8, Library Service 6, and Student Affairs 1. The image from the word cloud of question data collected can be seen in Figure 4. Figure 4 shows the words often appearing in the questions in the datasets resulting from data collection. The results of presenting a combination of questions equipped with their categories can be seen in Figure 5.

	kategori	pertanyaan
0	ICT	I can not access my PUIS account
1	ICT	What is PUIS and how does it work?
2	ICT	What are the benefits of using PUIS?
3	ICT	How can I access PUIS?
4	ICT	Is there a user guide available for PUIS?

Figure 2. The Results of Collecting Questions from the Informants

Student Services	92
Academic	90
Marketing	24
ICT	20
Financial Services	16
Internship	8
Library Service	6
Student Affair	1
Name: kategori, dtype: int64	

Figure 3. Classification of Questions based on Functional Academic Services in Tertiary Institutions

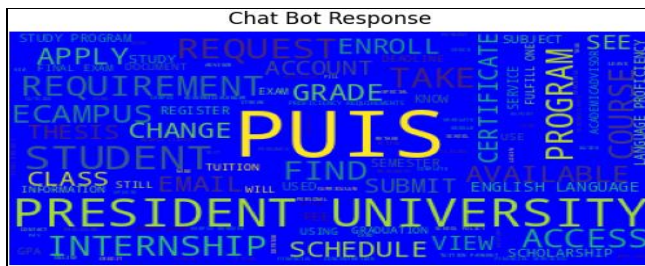


Figure 4. Word Cloud from the Questions that Have Been Collected

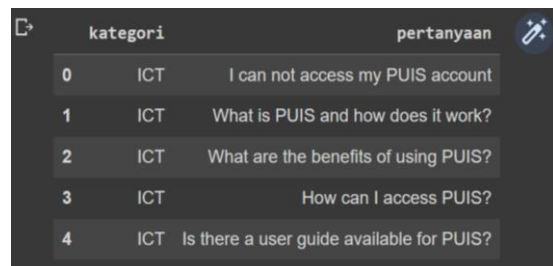


Figure 5. Question Data and its Categories

From the results of the data that has been classified, the division is carried out, namely data testing and data training, which are used to train the chatbot engine to study data and classify question categories automatically based on the questions submitted or inputted. The script used to divide the data into testing data and training data is "X\_train, X\_test, y\_train, y\_test = train\_test\_split(questions, labels, test\_size=0.2, random\_state=42)". Then weighting is carried out using the TFIDF vectorizer using training data and data testing that has been split before using the formula:

```
vectorizer = TfidfVectorizer()
X_train_tfidf = vectorizer.fit_transform(X_train)
X_test_tfidf = vectorizer.transform(X_test)
```

TFID gives weight to a word to form a term (word relationship). In this case, TFID gives weight to the questions the chatbot asks. Next, create a chatbot engine model using the Support Vector Machine (SVM) with the following command:

```
# SVM model training
svm_model = svm.SVC()
svm_model.fit(X_train_tfidf, y_train)
```

To find out the performance of the model that has been made, it is necessary to measure the accuracy that ensures the performance of the chatbot engine using the formula:

```
# Predict on the test set
y_pred = svm_model.predict(X_test_tfidf)
# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
Accuracy: 0.5769230769230769
```

Based on the accuracy information obtained, it is 0.57, which means that the accuracy of the chatbot engine is 57% in classifying the questions asked. In addition, the results of the classification report were found, as shown in Figure 6.

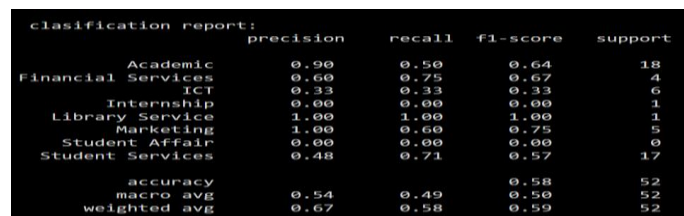


Figure 6. Classification Report

The precision shown in Figure 6 shows the value of the number of relevant documents found compared to the number of all relevant documents in the collection of questions in the dataset. Meanwhile, the recall in Figure 6 shows the number of relevant documents found compared to the apparent number of relevant documents in the collection of questions in the dataset. The F1-score in Figure 6 compares precision and weighted average gain. Then a model trial was carried out, which was able to answer the performance of the chatbot engine model using the following formula:



```

new_data = pd.DataFrame({'text': ["I want to apply for study leave at president university?"]})
new_documents = new_data['text']
new_tfidf_matrix = vectorizer.transform(new_documents)
new_predictions = svm_model.predict(new_tfidf_matrix)
print(new_predictions)

```

The question used to test the chatbot engine model is "I want to apply for a study leave at president university?" and the engine predicts the category of the question is "Academic" based on question data on the list collected from sources, with a model accuracy of 57% resulting in an accuracy that matches the list of sources.

### Discussion

The process presented to create a chatbot model that can support academic services in higher education needs to pay attention to several things, including collecting data to form datasets. This data must be obtained from the university developing the chatbot because each university has a different division or culture name. Getting a general chatbot that can classify correctly is possible, so record datasets need to be multiplied to train the chatbot machine (Hikmah et al., 2022; Zulkarnain et al., 2020). The more datasets used, the better the accuracy of the data obtained. In addition, TF-IDF (Term Frequency-Inverse Document Frequency) must also be considered in word weighting (Alfarizi et al., 2022). In developing technology in the digital era, like today, chatbot services are needed to maximize the provision of information to students. Chatbot services allow students to obtain accurate information through indirect communication using text, sound, and visuals (Cannavaro, 2023; Sarosa et al., 2020; Zulkarnain et al., 2020). Chatbot services can act as automatic conversation agents who can interact and communicate using human language, making it easier for individuals to obtain information anywhere and anytime (Sarosa et al., 2020; Supriyanto & Taufik, 2023). In education, chatbots can provide various information services for students (Kanetaki et al., 2022; Yağcı, 2022).

Furthermore, applying the SVM algorithm to chatbot services will enable developers to make predictions in regression and classification cases. The application of the SVM algorithm allows the creation of separator functions (hyperplanes) for objects with different characteristics (Hidayat, 2021; Junaedy et al., 2022). Support Vector Machine (SVM) is a method in supervised learning that can be used for classification (such as Support Vector Classification) and regression (Support Vector Regression) (Pallathadka et al., 2023; Sudianto et al., 2022). In classification modeling, SVM has a clear and mathematical concept. It can solve linear and non-linear classification and regression problems to provide the best service and fast and precise information. Chatbot development with the SVM algorithm can be one of the right strategies to improve services, reduce operational costs, and support interactive services (Adamopoulou & Moussiades, 2020; Almustaqim & Toscani, 2022; Eren, 2021). The results obtained in this study are in line with the results of previous research, which also revealed that chatbots can help improve the quality of education through maximum service (Zulrahman et al., 2023). Chatbots can potentially support smart services in smart libraries and can improve the performance of the new student admissions process (Amrullah et al., 2022). The results of other studies reveal that chatbot applications can improve the academic service process (Sugiono, 2022). Based on some of these research results, the chatbot application is very feasible to improve academic services and educational performance.

### 4. CONCLUSION

Based on the data analysis and discussion results, it can be concluded that the academic management chatbot model that uses the SVM algorithm can classify questions submitted through chatbots with an accuracy of 57% performing support services.

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