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Submission date: 26-Jun-2026 03:10PM (UTC+0900)
Submission ID: 2989721760
File name: similarity_132.docx (2.95M)
Word count: 3520
Character count: 21105

A Comprehensive Analysis Of Student Feedback On The Curriculum, Lecturers, And Facilities At STMIK Mardira Indonesia Using A Statistical Approach And Machine Learning Natural Language Processing

Abstract

Enhancing the quality of higher education necessitates a thorough review of student feedback. Nonetheless, STMIK Mardira Indonesia continues to handle input manually, which challenges its ability to manage substantial amounts of both quantitative and qualitative data effectively. As a result, the institution fails to draw on numerous useful insights from student feedback.

This research aims to develop an integrated system that autonomously analyzes student input using statistical and machine-learning methods. The technology displays outcomes via an interactive dashboard to facilitate data-driven decision-making for management. The research employs a hybrid technique, integrating CRISP-DM for data analysis and Machine Learning with the Prototype method for system development.

The data analysis encompasses descriptive statistics for quantitative data (Likert scale) and Natural Language Processing (NLP) employing a Linear SVM model for sentiment classification of qualitative data (comments). The research yields a web-based system prototype that effectively consolidates the collection and analysis of student input on the curriculum, instructors, and facilities. The Linear SVM sentiment classification model has outstanding performance, with an accuracy of 95.2% on the test dataset. Moreover, the interactive dashboard effectively illustrates these outcomes through dynamic filtering. Consequently, the integration of statistical and Machine Learning methodologies successfully converts raw feedback into organized insights, equipping STMIK Mardira Indonesia with a reliable instrument to sustainably improve educational service quality.

Keywords : *: Sentiment Analysis, Natural Language Processing (NLP), Machine Learning, Student Feedback, Information Systems, Dashboard*

INTRODUCTION

Enhancing the quality of higher education is essential to addressing the challenges of the Industrial Revolution 4.0, requiring institutions to remain adaptable and data-driven. Student feedback is a fundamental element of quality assessment, as mandated by the Directorate General of Higher Education, Research, and Technology, making it a requisite component of the Internal Quality Assurance System. This feedback captures students' perceptions of essential components, including curriculum, instructor effectiveness, and infrastructure.

With technological advancements, students increasingly provide feedback across multiple digital platforms, generating substantial amounts of both quantitative (rating scales) and qualitative (textual comments) data. This unstructured qualitative data contains profound insights, although it is challenging to handle manually. Manual analysis is time-consuming and susceptible to interpretational bias, resulting in the oversight of numerous valuable contributions.

At STMIK Mardira Indonesia, the existing assessment procedure continues to rely on manual questionnaire compilation, leading to qualitative remarks that lack comprehensive analysis. This circumstance generates a disparity between gathered data and strategic decision-making. This project proposes the development of a comprehensive web-based analytical system that incorporates descriptive statistical methods for quantitative data and Natural Language Processing (NLP) for sentiment analysis of qualitative data.

A. Fundamental Principles of Educational Assessment

Feedback constitutes a student-centered cyclical process designed to achieve a particular outcome. A positive effect entails a voluntary attention span and student involvement in instructional delivery (Sunar & Khalid, 2024). Law Number 20 of 2003 regarding the National Education System, a principal reference in contemporary curriculum studies, defines the curriculum as a compilation of plans and arrangements about objectives, content, instructional materials, and methodologies that guide the organization of learning activities to attain designated educational goals.

(Shaik et al., 2022) assert that lecturers constitute a vital element of the higher education system. The roles, obligations, and responsibilities of lecturers are crucial in achieving national education objectives, namely in teaching the populace and enhancing the quality of the Indonesian citizenry. This encompasses enhancing religion, devotion, virtuous character, and proficiency in science, technology, and the arts, while also promoting a progressive, equitable, prosperous, and cultured Indonesian society.

Educational facilities include all physical and material resources that enhance the teaching and learning process, such as classrooms, instructional aids, textbooks, libraries, and laboratories, which collectively promote effective learning (Kang et al., 2022).

B. Quantitative Data Analysis

Descriptive statistics is a field of statistical research that emphasizes the collection, processing, presentation, and analysis of quantitative data succinctly. Its objective is to enhance the comprehension and analysis of information obtained from such data (Borakati, 2021). The average, or mean, of a dataset encapsulates the general attributes of that data (Wulff et al., 2023). Mathematically, the mean is articulated as follows:

$$\bar{X} = \frac{X_1 + X_2 + \cdots + X_n}{n}$$

Where:

\bar{X} = average

X = data value

n = lots of data

C. Qualitative Data Analysis

NLP is a discipline within computer science and linguistics that examines the interaction between humans and computers using natural language (Deshpande et al., 2025). The Natural Language Processing workflow encompasses multiple preparatory stages, as outlined below:

Case Folding: This word-processing procedure transforms uppercase letters into lowercase. This procedure also eliminates numbers and special symbols—such as exclamation marks (!), commas (,), slashes (/), greater-than symbols (>), and less-than symbols (<)—that do not significantly aid classification.

Tokenization: This procedure segments text into distinct terms, using spaces as separators. It seeks to segregate each word, guaranteeing its autonomy from other phrases.

Stemming: This phase produces the base form of a word by eliminating suffixes or prefixes, such as "in-", "-nya", and others.

Stopword Removal: This filtering procedure identifies and removes words that have minimal semantic value in a sentence, such as "ini" (this). This stage enhances categorization efficiency by removing commonly occurring words that lack significant impact. Stopwords are a set of

frequently occurring words that offer little informational value. Indonesian stopwords include "ke" (to), "di" (in), and "yang" (which/that).

Term weighting denotes the assignment of weights to individual words to improve sentiment analysis in text mining. This study used the Term Frequency-Inverse Document Frequency (TF-IDF) technique. Term Frequency ($tf(w,d)$) signifies a word's significance based on its frequency of occurrence within a document. In contrast, Inverse Document Frequency (IDF) assigns weights based on the frequency of a term across the entire corpus of documents (Bashir et al., 2016). Term Frequency (TF) quantifies the occurrence of a term within a document. The subsequent equation articulates this relationship:

$$TF(t,d) = \frac{\text{amount t in d}}{\text{number of words in d}}$$

Inverse Document Frequency (IDF) is crucial in determining the frequency of a word's occurrence across all texts, as represented by the following equation:

$$IDF(t) = \log \frac{\text{total number of documents}}{\text{number of documents containing t}}$$

Subsequently, the TF-IDF evaluation is performed. This is accomplished by multiplying the TF equation by the IDF equation, as illustrated in the formula:

$$TF\,IDF = TF(t,d) \times IDF(t)$$

Sentiment analysis is the computer analysis of opinions, sentiments, and emotions expressed in text. This method is a prevalent instrument for examining social media trends in marketing, social, and political domains (Mejeh & Rehm, 2024).

Machine Learning (ML) comprises algorithms and statistical models that empower computers to execute specified tasks autonomously; these systems identify patterns and draw inferences from data (Ötleş et al., 2021). Machine learning development entails constructing models trained on designated datasets, then processing new data to produce predictions (Ötleş et al., 2021). Researchers continue to investigate and employ diverse model types for machine learning systems.

D. Data Visualization

A dashboard functions as a computer interface that displays an array of charts, graphs, reports, visual indications, and alerts, consolidated into a singular, dynamic information platform (Rybinski & Kopciuszewska, 2021).

This research seeks to define the system architecture, implement a comprehensive data analysis methodology, and develop a prototype interactive dashboard. This dashboard presents the analysis results, functioning as a potent and efficient instrument for data-driven decision-making. Thus, the system provides STMIK Mardira Indonesia's administration with actionable insights to improve the quality of educational services sustainably.

METHOD

This study employs a qualitative approach with a descriptive-analytical focus. To achieve the research objectives, the study adopts a hybrid approach comprising two primary methodologies: the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework to develop the sentiment analysis module, and the Prototype Method for the dashboard application development.

a. Metode Cross-Industry Standard Process for Data Mining (CRISP-DM)

This study employs the CRISP-DM framework for data analysis and model development. The research advances via the subsequent phases:

Business Understanding: This phase delineates the business purpose of automating sentiment classification from student comments to facilitate strategic decision-making.

Data Comprehension: This step uses a labeled synthetic dataset of student feedback (positive, negative, neutral) to establish the ground truth.

Data Preparation: This phase encompasses qualitative text preprocessing, including case folding, tokenization, stopword elimination, and stemming to cleanse and standardize the data.

Table 1. NLP Process

No	Original Comment	Folding Case Results	Folding Case Results	Stopword Removal Results	Stemming Results (Final Results)
1	Please repair and improve the study rooms and campus facilities.	Please repair and improve the study rooms and campus facilities.	['please', 'in', 'fix', 'and', 'in', 'improve', 'space', 'study', 'and', 'facilities', 'campus']	['please', 'fix', 'improve', 'space', 'study', 'facilities', 'campus']	['please', 'good', 'level', 'room', 'teach', 'facilities', 'campus']

Modeling: This phase converts text into numerical representations using TF-IDF and trains classification models. The research assesses multiple algorithms, such as Logistic Regression, Linear SVC, Naive Bayes, and Random Forest Classifier.

Evaluation: This phase assesses model efficacy by partitioning the dataset into training (80%) and test (20%) sets. The system evaluates performance using metrics such as accuracy, precision, recall, and F1-score, derived from the classification report and confusion matrix. The Linear SVC model attains optimal performance with the subsequent results:

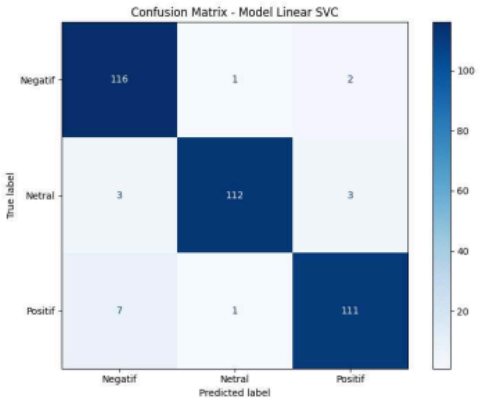

Figure 1. Confusion Matrix Results

The confusion matrix indicates that the principal diagonal, signifying accurate predictions, comprises 116 instances for the Negative class, 112 for Neutral, and 111 for Positive. In contrast, the off-diagonal values indicate the number of data points the model incorrectly classified.

```
Model Terbaik: Linear SVC
Akurasi pada Data Uji: 95.22%

Laporan Klasifikasi:
              precision    recall  f1-score   support

     Negatif       0.92      0.97      0.95       119
      Netral       0.98      0.95      0.97       118
     Positif       0.96      0.93      0.94       119

    accuracy                           0.95       356
   macro avg       0.95      0.95      0.95       356
weighted avg       0.95      0.95      0.95       356
```

Figure 2. Classification Report Results

The Classification Report indicates an overall accuracy of 95.2%. This number indicates that the model accurately classifies 339 of 356 test data items, reflecting outstanding overall performance.

Deployment: This concluding phase preserves the optimal model and vectorizer in .pkl format for use in the web application. This integration enables the system to perform real-time sentiment analysis of recent student feedback.

b. Prototype Method

The creation of the system interface, particularly the interactive dashboard, utilizes the Prototype Method. This study employs this strategy due to its facilitation of iterative development and incorporation of direct user assessment for system enhancement. The development process adheres to the following stages:

Identification: This phase delineates and examines the functional and non-functional requirements for the dashboard from the management's viewpoint.

Design and Construction: This phase involves creating and assembling the preliminary dashboard interface for data visualizations.

Evaluation: Users assess the prototype and offer input for enhancements.

Refinement: This concluding phase enhances and refines the dashboard in accordance with user feedback until the system fully meets user specifications.

RESULT AND DISCUSSION

This section outlines the design, implementation, and testing outcomes of the student feedback analysis system and evaluates its efficacy in resolving the stated issues.

a. Design

1) Usecase Diagram

The Use Case Diagram below depicts the functional interactions between users and the proposed Feedback Analysis System. The system recognizes three principal entities: Student, Admin, and Management.

The figure shows that students can register and complete questionnaires. The Administrator can authenticate registrations and oversee master data, including lecturers, courses, and questions. Simultaneously, Management possesses the access rights to view the analysis results dashboard. Most essential functions—such as Completing Questionnaire, Authenticating User, Managing Data, and Accessing Dashboard—necessitate a Login procedure. This criterion utilizes a <> connection to guarantee secure access based on user privileges.

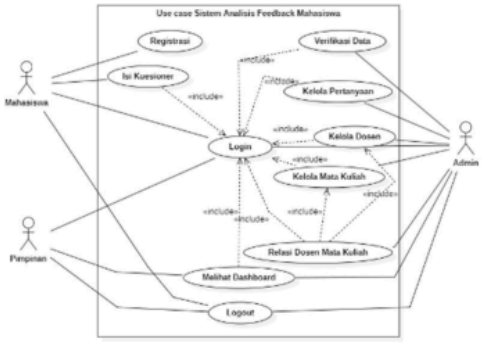

Figure 3. Student Feedback Analysis System Usecase

2) Usecase Diagram Scenario

Table 2. Questionnaire Content Usecase Scenario

Use case name	Fill out the questionnaire
ID	UC-03
Actor	Student
Deskripsi Singkat	Students provide feedback by filling out the questionnaire provided.
Initial Conditions	The student has successfully logged into the system.
Final Condition	Student feedback data has been successfully stored in the database.
Normal Flow	1. Students select the "Fill Out Questionnaire" menu. 2. The system displays a hybrid questionnaire page (Likert scale and text fields). 3. Students complete all questions on the questionnaire. 4. Students click the "Send Feedback" and "Finish" buttons. 5. The system saves the answers to the database. 6. The system displays the message "Thank you, your feedback has been successfully saved."
Alternative Flow	**3a.** If there are mandatory questions that have not been filled in, the system will display a notification to complete the form.

Table 3. Usecase Scenario Viewing Dashboard

Use case name	View Dashboard
ID	UC-09
Actor	Admin and Leader
Short Description	Admin/Leader sees a summary of the results of the student feedback analysis in the form of interactive data visualization.

Initial Conditions	Admin/Leader has successfully logged into the system.
Final Condition	Admins/Leaders can view and interact with the analysis dashboard.
Normal Flow	1. The admin/leader selects the "Analysis" menu. 2. The system retrieves relevant feedback data from the database. 3. The system performs real-time analysis (statistics and sentiment). 4. The system displays a dashboard page containing data visualizations (graphs, word clouds, etc.). 5. The leader can interact with the dashboard (for example, using filters).
Alternative Flow	**2a.** If no Feedback data is found for the selected period, the system will display the message "Data not available".

b. Activity Diagram

The subsequent activity map delineates the principal workflow and operational logic of the web-based student feedback analysis system:

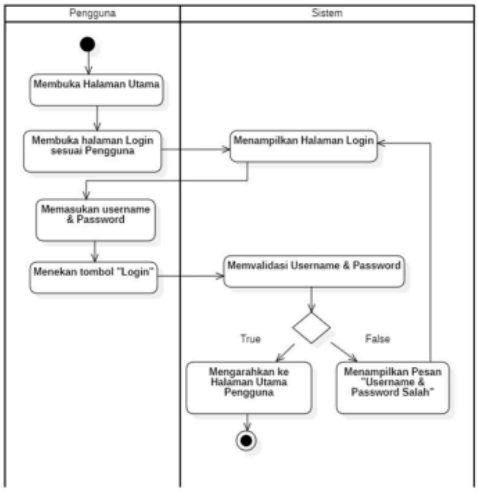

Figure 4. Login Activity Diagram

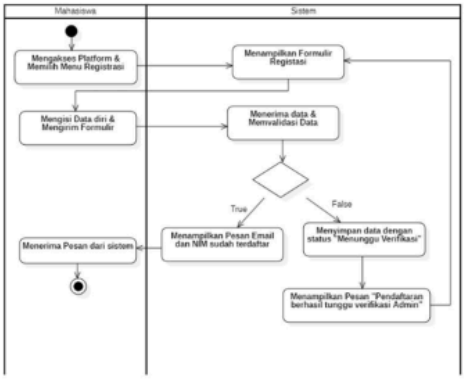

Figure 5. Registration Activity Diagram

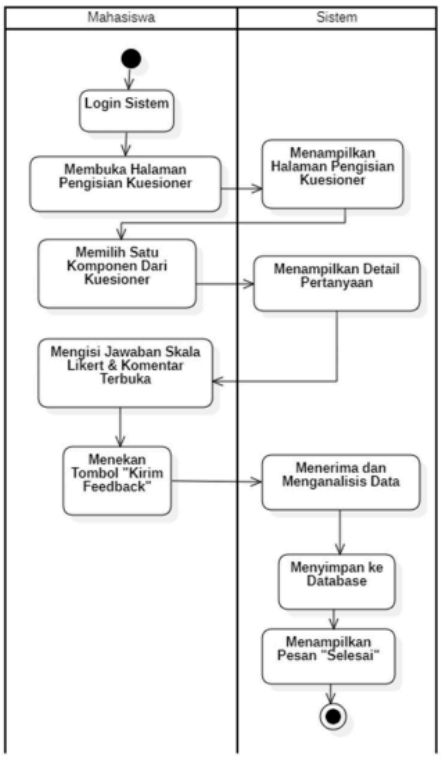

Figure 6. Activity Diagram for Filling Out the Questionnaire

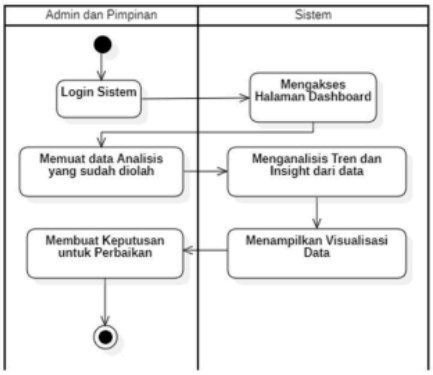

Figure 7. Activity Diagram Viewing the Dashboard

c. Sequence Diagram

The Sequence Diagram illustrates the relationships among objects during the student feedback submission procedure. This figure depicts the message flow, commencing with the user entering data via the interface, followed by the system controller validating the input, and culminating in the database archiving the feedback data.

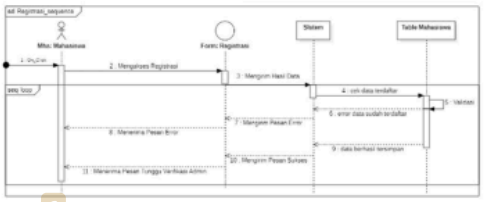

Figure 8. Register Sequence Diagram

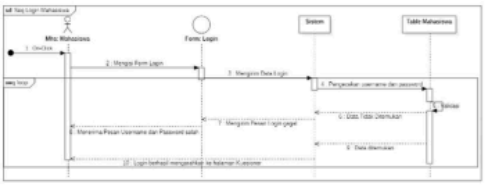

Figure 9. Login Sequence Diagram

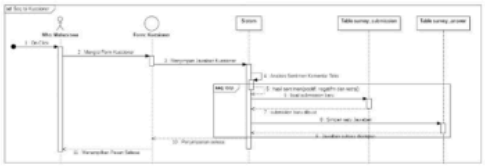

Figure 10. Sequence Diagram of Questionnaire Filling

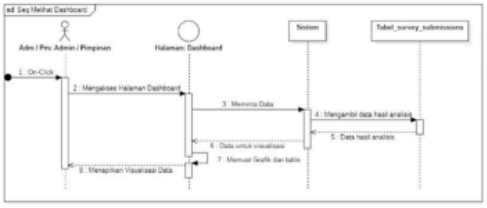

Figure 11. Sequence Diagram Viewing the Dashboard

d. Class Diagram

The Class Diagram illustrates the entities that comprise the system and the interrelations among the object classes inside the system architecture.

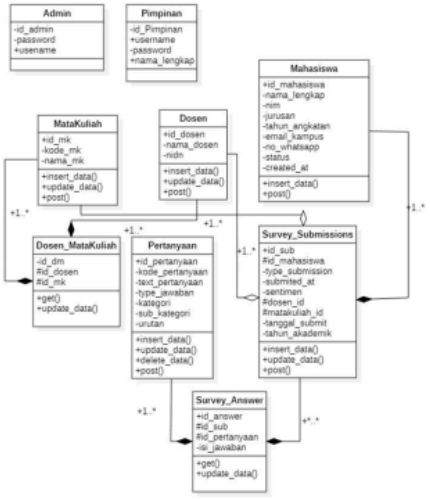

Figure 12. Class Diagram

e. Database Implementation

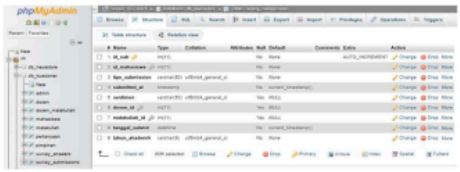

Figure 13. Survey submissions table

f. Interface Implementation

During the implementation phase, the interface is developed according to the design established in the preceding stage to enhance user comprehension of the system.

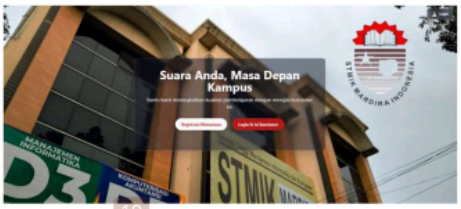

Figure 14. Main Page

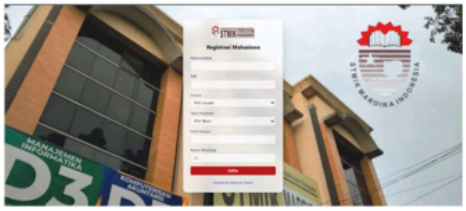

Figure 15. Registration Page

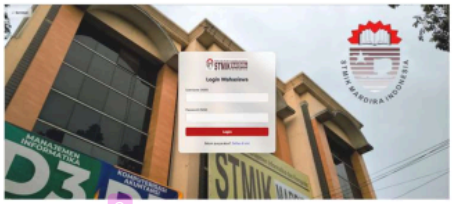

Figure 16. Login Page

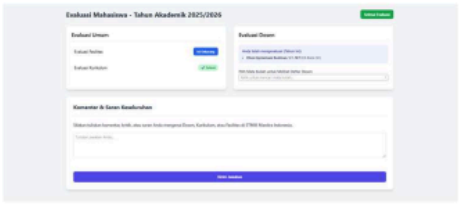

Figure 17. Questionnaire Filling Page

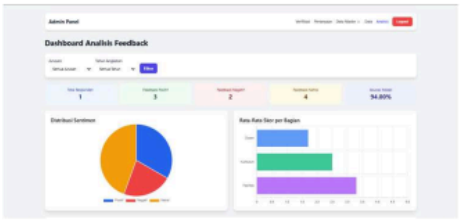

Figure 18. Dashboard page

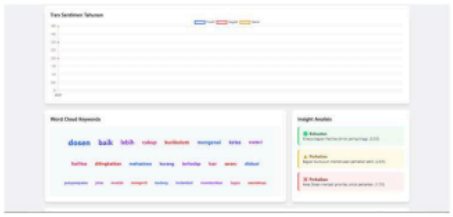

Figure 19. Dashboard page

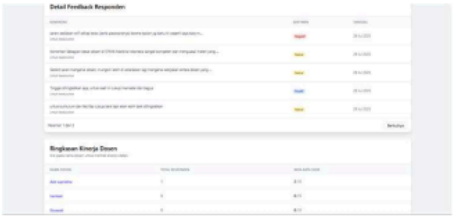

Figure 20. Dashboard page

g. Testing

The system testing process verifies the proper functionality of each intended feature. This study utilizes the Blackbox Testing methodology, which emphasizes evaluating functionality without analyzing the internal code architecture. The testing scenarios include all essential system activities, from user registration to data visualization for management purposes. Each scenario defines clear steps and expected outcomes to compare against the actual testing results.

Table 4. Blackbox Testing Scenarios

ID	Testing Scenario	Testing Steps	Expected results	Test Results	Conclusion
TC-01	Student Registration (Normal Flow)	1. Open the main page and select "Register." 2. Fill out the form with valid data that isn't already registered. 3. Click the "Register" button.	The system saves the data with the status "Waiting for Verification" and displays a success message.	As Expected	VALID
TC-02	Student Registration (Alternative Flow - Registered Student ID)	1. Open the registration page. 2. Fill out the form with your student ID number. 3. Click the "Register" button.	The system rejects the registration and displays the error message "NIM is already registered".	As Expected	VALID
TC-03	Valid Login (Student)	1. Open the login page. 2. Enter valid and verified student credentials. 3. Click the "Login" button.	The system directs you to the Student main page (dashboard).	As Expected	VALID
TC-04	Valid Login (Admin)	1. Open the login page. 2. Enter valid admin credentials. 3. Click the "Login" button.	The system directs you to the Admin main page (dashboard).	As Expected	VALID
TC-05	Valid Login (Leader)	1. Open the login page. 2. Enter valid Leader credentials. 3. Press the "Login" button.	The system directs to the main page (dashboard) of the Leader.	As Expected	VALID
TC-06	Invalid Login (Incorrect Credentials)	1. Open the login page. 2. Enter an incorrect username or password. 3. Press the "Login" button.	The system displays the message "Incorrect username or password" and remains on the login page.	As Expected	VALID
TC-07	Filling Out the Questionnaire (Normal Flow)	1. Log in as a student. 2. Select the "Fill Out Questionnaire" menu. 3. Complete all mandatory questions. 4. Click the "Send Feedback" button.	The system saves the data and displays the message "Thank you, your feedback has been saved successfully".	As Expected	VALID
TC-08	Filling Out the Questionnaire (Alternative Flow	1. Log in as a student. 2. Open the questionnaire but	The system displays a notification to complete the blank fields.	As Expected	VALID

ID	Testing Scenario	Testing Steps	Expected results	Test Results	Conclusion
	- Fill in the Blanks)	don't fill in the questions. 3. Click the "Send Feedback" button.			
TC-09	Admin Verifies Registration	1. Log in as Admin. 2. Select the "Verify" menu. 3. Select a student, then click "Verify." 4. Click "Send WhatsApp."	The student account status changed to "Verified" and the WA notification was successfully sent.	As Expected	VALID
TC-10a	(Create) Add new lecturer data	1. Log in as an admin. 2. Go to the "Manage Lecturers" menu. 3. Click "Add Data", fill out the form, and save.	The new lecturer data has been successfully saved and appears in the list.	As Expected	VALID
TC-10b	(Read) View list & details of lecturers	1. Go to the "Manage Lecturers" menu. 2. Go to the Lecturer Data page.	The lecturer list appears correctly. The details page displays all information accurately.	As Expected	VALID
TC-10c	(Update) Changing Lecturer data	1. Go to the "Manage Lecturers" menu. 2. Select the data, click "Edit," edit the information, and then save.	Lecturer data has been successfully updated. Changes are visible in the list and details pages.	As Expected	VALID
TC-10d	(Delete) Delete lecturer data	1. Go to the "Manage Lecturers" menu. 2. Select the data and click "Delete." 3. Confirm the deletion.	Lecturer data is deleted from the list and database.	As Expected	VALID
TC-11a	(Create) Add new course data	1. Log in as an admin. 2. Go to the "Manage Courses" menu. 3. Click "Add Data", fill out the form, and save.	New course data has been successfully saved and appears in the list.	As Expected	VALID
TC-11b	(Read) View the list & details of courses	1. Go to the "Manage Courses" menu. 2. Go to the Course Data page.	The course list is displayed correctly and the detailed information is accurate.	As Expected	VALID
TC-11c	(Update) Changing Course Data	1. Go to the "Manage Courses" menu. 2. Select the data, click "Change," edit the information, and then save.	Course data has been successfully updated.	As Expected	VALID
TC-11d	(Delete) Delete course data	1. Go to the "Manage Courses" menu.	Course data is deleted from the list and database.	As Expected	VALID

ID	Testing Scenario	Testing Steps	Expected results	Test Results	Conclusion
		2. Select the data and click "Delete." 3. Confirm the deletion.			
TC-12a	(Create) Defines a new relationship	1. Log in as an Admin. 2. Go to the "Manage Relationships" menu. 3. Select the Lecturer and Course, then save the relationship.	The relationship data was successfully saved.	As Expected	VALID
TC-12b	(Read) View the list of relations	1. Go to the "Manage Relationships" menu.	The list of relationships between Lecturers and Courses taught appears correctly.	As Expected	VALID
TC-12c	(Delete) Delete a relationship	1. Go to the "Manage Relationships" menu. 2. Select a relationship and click "Delete." 3. Confirm the deletion.	Relationship data successfully deleted.	As Expected	VALID
TC-13a	(Create) Add a new question	1. Log in as an admin. 2. Go to the "Questions" menu. 3. Click "Add Question," fill out the form, and save.	The new question was successfully saved and appears in the list.	As Expected	VALID
TC-13b	(Read) View the list of questions	1. Go to the "Questions" menu.	All questionnaire questions appear correctly.	As Expected	VALID
TC-13c	(Update) Changed the question	1. Go to the "Questions" menu. 2. Select a question, click "Edit," edit the question, and then save it.	Question updated successfully.	As Expected	VALID
TC-13d	(Delete) Delete a question	1. Go to the "Questions" menu. 2. Select a question and click "Delete." 3. Confirm the deletion.	The question was successfully deleted from the questionnaire.	As Expected	VALID
TC-14	Viewing the Dashboard (Normal Flow)	1. Log in as an Admin or Leader. 2. Select the "Analysis" / "Dashboard" menu.	The system displays a dashboard page with relevant data visualizations.	As Expected	VALID

ID	Testing Scenario	Testing Steps	Expected results	Test Results	Conclusion
TC-15	View Dashboard (Alternative Flow - Empty Data)	1. Log in as an Admin or Leader. 2. Open the dashboard when feedback data is not yet available.	The system displays the message "No Data Yet" on the dashboard page.	As Expected	VALID
TC-16	Logout from System	1. Log in as one of the actors. 2. Press the "Logout" button.	The system successfully terminated the session and redirected to the login page.	As Expected	VALID

CONCLUSION

This study effectively establishes an extensive web-based system for the management and analysis of student feedback at STMIK Mardira Indonesia. The system incorporates two analytical approaches: descriptive statistics for quantitative data (Likert scales) and Natural Language Processing (NLP) using a linear SVM for sentiment analysis of qualitative data (comments). The technology subsequently presents these analytical results on an interactive dashboard, intended to aid management in making data-driven strategic decisions.

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