DIJEMSS:
Dinasti International Journal of Education Management and Social Science
E-ISSN: 2686-6331
P-ISSN: 2686-6358
https://dinastipub.org/DIJEMSS dinasti.info@gmail.com +62 811 7404 455
DINASTI PUBLISHER
DOI: https://doi.org/10.38035/dijemss.v6i6

Improving the Academic Environment and Teaching Quality through Data Segmentation and Decision Trees

Nia Kusuma Wardhani[1], Windu Gata[2]
[1]Universitas Mercu Buana, Jakarta Barat, Indonesia, nia.kusuma@mercubuana.ac.id
[2]Universitas Nusa Mandiri, Jakarta Pusat, Indonesia, windu@nusamandiri.ac.id

Corresponding Author: nia.kusuma@mercubuana.ac.id[1]

Abstract: This study aims to assess and segment graduate student satisfaction in the Master of Management Program at UMB, focusing on academic services and teaching quality, using a data-driven approach through K-Means clustering and Decision Tree classification. The K-Means method successfully identified three distinct satisfaction clusters: Very Satisfied, Satisfied, and Dissatisfied. From an HRD perspective, this segmentation provides strategic insights into how students perceive institutional service delivery—spanning administrative processes, supporting infrastructure, and interaction quality across service units. These insights reflect the internal customer experience, which is critical in managing human capital performance within higher education institutions. The clustering results were further examined using a Decision Tree to identify key attributes driving satisfaction levels. Factors such as clarity in professional certification procedures (K55), responsiveness of certification services (K56), and management service quality (K78) emerged as dominant predictors of satisfaction in the service domain. In the teaching domain, lecturer empathy (K03) and responsiveness (K01) were shown to significantly influence student engagement and academic trust—two core components in HRD models for faculty performance. These findings suggest the need for targeted capacity-building programs, soft skill enhancement, and infrastructure development. By integrating student feedback into ongoing HR practices and quality assurance mechanisms, institutions can foster a more human-centered, responsive, and effective educational environment.

Keyword: Clustering, Decision Tree, SERVQUAL, Higher Education, CRISP-DM.

INTRODUCTION

Universitas Mercubuana (UMB) is one of the leading private universities in Indonesia. To maintain and enhance the quality of services and the teaching-learning process, a systematic analysis of student satisfaction is required. User (student) satisfaction has been assessed using a Likert scale (1 to 5), with the results serving as the basis for semesterly evaluations by the quality assurance unit and internal evaluations.

In previous research, the evaluation of the e-learning system was conducted using the PIECES framework, which involves analyzing aspects of performance, Information, Economic,

Control, Efficiency, and Service (Wardhani, N. K., & Gata, W. 2018). The study indicated that UMB's e-learning system has achieved a high level of efficiency based on user perceptions. Previous studies have demonstrated that decision tree methods can be applied to identify dominant factors influencing learning outcomes and student satisfaction. For instance, Kim (W. S. Kim , 2016) explained how a multiple decision tree model can address multicollinearity issues and produce an easily understandable model to support decision-making in the education sector. Pandey and Sharma (Pandey, M., & Kumar Sharma, V. 2013). compared various decision tree algorithms, such as J48 and CART, to predict student performance, showing that the J48 algorithm provides the best accuracy in classification.

In a more adaptive context, Matzavela and Alepis (Matzavela, V., & Alepis, E. 2021). proposed the application of decision trees in dynamic and personalized m-learning environments. Meanwhile, Bassi (F. Bassi, 2018) applied a latent clustering model to longitudinally measure changes in student satisfaction with teaching over several academic years. Clustering techniques were also used by (Hidayati, N et al. 2020) to analyse the importance of the learning system at Universitas Terbuka using the k-medoids algorithm.

Additionally, (Kurniah et al. 2022) applied the C4.5 algorithm to evaluate satisfaction with academic and student services, while (Rohman and Wibowo, 2023) utilized the C4.5 decision tree in the context of the Merdeka Belajar-Kampus Merdeka (MBKM) program to predict student satisfaction levels. (M.A. Lopez-Cueva et al,2024) also demonstrated that decision trees outperform logistic regression in predicting student satisfaction based on 20 predictor variables.

Lastly, (Jia, S., & Pang, Y. ,2018). introduced an enhanced decision tree model using the Fayyad boundary theorem to evaluate teaching quality by integrating learner behavior data. This literature underscores the urgency and potential of developing a data-driven quality improvement model through segmentation (clustering) and decision tree approaches in the context of evaluating services and teaching at UMB.

This study aims to perform segmentation based on student evaluation results using clustering methods, followed by the application of decision trees to identify the primary attributes most influencing student satisfaction levels. The results of this analysis are expected to provide strategic insights for improving the quality of academic services in higher education. The dataset is sourced from UMB's User Satisfaction Bureau, collected every semester regarding satisfaction with services and lecturer teaching, specifically for postgraduate (S2) students in the Master of Management (MM) program, using the SERVQUAL dimensions (Foropon, C., et al., 2013), (A. Utkirov, 2024), (Manunggal, B., & Afriadi, B.,2023) (S. Karomah, et al.,2023), namely: Assurance, Empathy, Reliability, Responsiveness, and Tangible. The training conducted by Marlinda et al. (2024) is expected to develop PKK cadres who are more prepared and skilled in facing the challenges of modern technology, enabling them to adapt better to the evolving times. The evaluation of the training outcomes will provide insights into the extent of benefits gained by the participants and how much this training can contribute to improving the services desired by the community.

Based on these considerations, this study employs a segmentation model and decision tree from the perspective of Human Resource management to explore students' perceptions regarding the academic environment and teaching quality, as well as to identify the factors that need improvement. The analysis uses a questionnaire dataset obtained from UMB's User Satisfaction Bureau.

METHOD

This study referred to the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology, which consists of six stages: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment (Cazacu, M., & Titan, E. (2020), (S.

Moro,2011), (Martínez-Plumed, et al., 2019). This framework was used to systematically process and analyze the student satisfaction dataset from the Master of Management (S2 MM) program at UMB.

In the Business Understanding phase, the objective was to assess the level of student satisfaction with campus facilities and the quality of teaching services. This helped align the project with institutional goals for continuous improvement. In the Data Understanding phase, questionnaire data were collected from the UMB User Satisfaction Bureau, containing students' evaluations across multiple academic and administrative units.

The Data Preparation phase involved cleaning the data by removing duplicates, handling missing values, and transforming the data format for analysis. In the Modelling phase, The dataset was analyzed using Orange, an open-source data mining software. Here, segmentation was conducted using the K-Means algorithm to group students into three satisfaction categories: Very Satisfied, Satisfied, and Dissatisfied. A Decision Tree model was also built to identify key attributes influencing the segmentation, such as lecturer responsiveness and infrastructure quality.

During the Evaluation phase, the segmentation results and decision tree rules were interpreted to uncover dominant patterns. For example, poor online system performance (K05) and low lecturer responsiveness (K06) were strongly associated with the Dissatisfied cluster.

Finally, in the Deployment phase, the findings were translated into practical recommendations for the university. These included enhancing lecturer responsiveness, optimizing digital academic systems, improving infrastructure (e.g., internet and classrooms), and strengthening administrative services in critical areas. This structured approach provided clear, data-driven insights to support strategic improvements in academic service delivery at UMB.

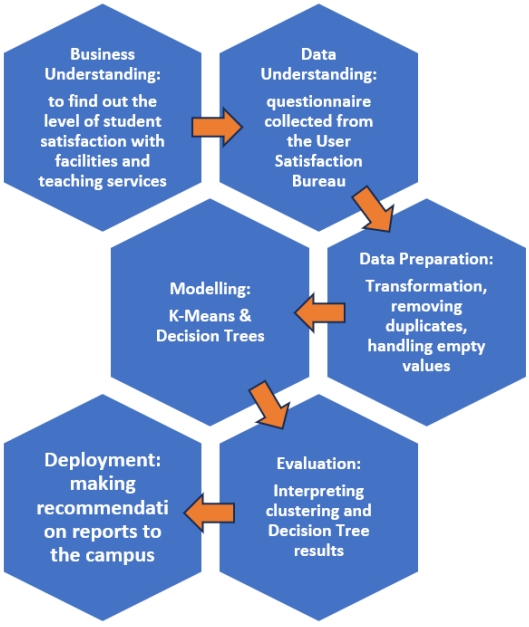

Figure 1. CRISP-DM Analysis of Services and Lecturer Teaching

RESULTS AND DISCUSSION

This study evaluates graduate student satisfaction in UMB's Master of Management Program using the CRISP-DM approach, covering business understanding, data preparation, modeling, evaluation, and deployment. K-Means clustering identified three satisfaction groups, Very Satisfied, Satisfied, and Dissatisfied, based on SERVQUAL dimensions. From an HRD perspective, key factors such as service quality, lecturer responsiveness, and empathy significantly influence satisfaction. These findings provide strategic insights for improving

academic services, guiding HR policies, and enhancing lecturer performance to support institutional development.

Business Understanding

This study aims to evaluate student satisfaction with the academic environment and the quality of lecturer teaching at UMB. By understanding student perceptions, the research seeks to identify strengths and areas needing improvement within the university's academic and service environments. Using a dataset from the UMB User Satisfaction Bureau, the study applies segmentation and decision tree models from the perspective of Human Resource management. The results are expected to provide meaningful insights that can guide the university in making data-driven decisions to enhance the quality of its services and teaching processes, ultimately improving the overall student learning experience.

The Business Understanding phase aims to comprehend the business needs and research objectives for services (Table 1), which involve evaluating student satisfaction levels with services at the S2 MM program of UMB, encompassing academic aspects, facilities, and bureau services, as well as identifying areas needing improvement based on the dimensions of responsiveness, assurance, empathy, reliability, and tangible.

The comprehensive assessment of student satisfaction in the Master of Management Program at UMB covers thirteen service domains. The Academic Atmosphere [K01–K05] focuses on creating a conducive environment for academic activities through student engagement, service quality, diversity harmony, and the availability of physical and internet facilities to support inclusive learning (Azis, A., et al.,2023). The Learning aspect [K06–K12] emphasizes lecturer responsiveness, subject mastery, empathy, consistency, and adequate learning infrastructure such as online systems and classroom equipment, aimed at enriching the student learning experience (Ruang Jurnal, 2022). The Entrepreneurship Bureau [K13–K17] evaluates the competence, friendliness, procedural clarity, speed, and facilities of staff supporting student entrepreneurial development (Ramadhani, N. T., & Nurnida, I.,2017)., while the Career, Relations, and Alumni Tracking Bureau [K18–K22] centers on career preparation, transparency, staff attitude, responsiveness, and alumni relations (A. R. Siregar, 2020).

Other critical areas include the Financial Administration Bureau [K23–K27], which ensures transparency and efficiency in financial services (A. F. Alamsyah., 2023), and the Academic Operations Bureau [K28–K32], which supports the smooth running of academic activities (A. K. Siregar.,2022). The Student Affairs Bureau [K33–K47] provides services in scholarships, counselling, and interest development, aiming to support student well-being (T. S. Purba.,2023). Health-related services are handled by the Human Resources Administration and Development Bureau [K48–K52], ensuring procedural clarity and readiness in student healthcare (R. Syaputri and B. Hartono., 2025). The Professional Certification Institute [K53–K57] strengthens student competence through professional certification services (S. Karomah.,2023), while the Student Admission Bureau [K58–K62] provides transparent and efficient admission processes (Sarofah, I., 2021). The Library Bureau [K63–K67] addresses academic resource availability and service quality (A. Ristha., 2023), and the Facilities and Infrastructure Bureau [K68–K74] focuses on the quality and functionality of campus facilities (A. Kurbani.,2022). Lastly, the Management Services [K75–K79] play a strategic role in maintaining professional, responsive, and transparent university operations (Fathurrahman et al., 2023).

Data Understanding

The data used in this study were obtained from questionnaires collected by the User Satisfaction Bureau. The respondents were active students enrolled in the S2 Master of

Management program. The dataset consists of two main parts: the first is an assessment of the academic environment, as outlined in Table 1, with a total of 1,170 records.

Table 1. The Academic Environment's Dataset

Code	Category	Subcategory	Description
K01	Academic Atmosphere	-	Academic activities run conducive at UMB.
K02	Academic Atmosphere	-	Scientific activities and community service are regularly held at UMB (e.g. social service and seminars) involving
K03	Academic Atmosphere	-	Good service from educational staff at UMB.
K04	Academic Atmosphere	-	Harmonious diversity in ethnicity religion race gender and disability at UMB.
K05	Academic Atmosphere	-	Good physical facilities and internet network at UMB.
K06	Learning	Responsiveness	Lecturers are willing to assist students in solving problems and responding to questions and comments.
K07	Learning	Assurance	Lecturers master the material provided and are fair and impartial in grading.
K08	Learning	Empathy	Lecturers care and motivate students to do their best.
K09	Learning	Reliability	Lecturers consistently deliver material and assessments openly and systematically.
K10	Learning	Tangible	The online lecture system is fast and easily accessible.
K11	Learning	Tangible	Lecturers inform about lecture regulations and provide sufficient learning materials in class.
K12	Learning	Tangible	Availability of classrooms and facilities such as computers internet microphones AC markers and projectors that function well.
K13	Entrepreneurship Bureau	Assurance	Entrepreneurship service staff are knowledgeable and transparent in providing services.
K14	Entrepreneurship Bureau	Empathy	Entrepreneurship service staff are polite courteous and friendly.
K15	Entrepreneurship Bureau	Reliability	Procedures and information systems for student entrepreneurship services are clear and reliable.
K16	Entrepreneurship Bureau	Responsiveness	Entrepreneurship service staff provide services quickly and responsively.
K17	Entrepreneurship Bureau	Tangible	Entrepreneurship services have complete facilities and infrastructure and a complaint channel is available.
K18	Career	Relations	and Alumni Tracking BureauAssuranceCareer guidance service staff are knowledgeable and transparent in providing services.
K19	Career	Relations	and Alumni Tracking BureauEmpathyCareer guidance service staff are polite courteous and friendly.
K20	Career	Relations	and Alumni Tracking BureauReliabilityProcedures and information systems for career guidance services are clear and easy to understand.
K21	Career	Relations	and Alumni Tracking BureauResponsivenessCareer guidance service staff provide services quickly and responsively.
K22	Career	Relations	and Alumni Tracking BureauTangibleCareer guidance services have complete facilities and infrastructure and a complaint channel is available.
K23	Financial Administration Bureau	Assurance	Financial staff are knowledgeable and transparent in providing services.
K24	Financial Administration Bureau	Empathy	Financial staff are polite courteous and friendly.
K25	Financial Administration Bureau	Reliability	Procedures and information systems of the financial department are clear and reliable.
K26	Financial Administration Bureau	Responsiveness	Financial staff provide services quickly and responsively to complaints.
K27	Financial Administration Bureau	Tangible	The financial department has complete facilities and infrastructure and a complaint channel is available.
K28	Academic Operations Bureau	Assurance	Academic administration staff are knowledgeable and transparent in providing services.
K29	Academic Operations Bureau	Empathy	Academic administration staff are polite courteous and friendly.
K30	Academic Operations Bureau	Reliability	Procedures and information systems for academic administration are clear and easy.
K31	Academic Operations Bureau	Responsiveness	Academic administration staff provide services quickly and responsively.
K32	Academic Operations Bureau	Tangible	Academic administration has complete facilities and infrastructure and a complaint channel is available.
K33	Student Affairs Bureau	Assurance	Information and procedures for scholarship services are clear and easy to understand.
K34	Student Affairs Bureau	Empathy	Scholarship service staff provide services quickly and responsively to complaints.
K35	Student Affairs Bureau	Reliability	Scholarship services are available and well-socialized.
K36	Student Affairs Bureau	Responsiveness	Scholarship selection is conducted transparently.

Code	Category	Subcategory	Description
K37	Student Affairs Bureau	Tangible	Scholarship service staff are polite courteous and friendly.
K38	Student Affairs Bureau	Assurance	Information and procedures for counseling services are clear and easy to understand.
K39	Student Affairs Bureau	Empathy	Counseling service professionals provide services quickly and responsively.
K40	Student Affairs Bureau	Reliability	Counseling and guidance services are available and well-socialized.
K41	Student Affairs Bureau	Responsiveness	Counseling and guidance services are handled by professionals according to the issues faced.
K42	Student Affairs Bureau	Tangible	Counseling service professionals are polite courteous and friendly.
K43	Student Affairs Bureau	Assurance	Reasoning interest and talent service staff are knowledgeable and transparent in providing services.
K44	Student Affairs Bureau	Empathy	Reasoning interest and talent service staff are polite courteous and friendly.
K45	Student Affairs Bureau	Reliability	Information and procedures for student interest and talent development services are clear and easy to understand.
K46	Student Affairs Bureau	Responsiveness	Reasoning interest and talent service staff provide services quickly and responsively.
K47	Student Affairs Bureau	Tangible	Reasoning interest and talent services have complete facilities and infrastructure and a complaint channel is available.
K48	Human Resources Administration and Development Bureau	Assurance	Information and procedures for health services are clear and easy to understand.
K49	Human Resources Administration and Development Bureau	Empathy	Health service staff are always on standby during operational hours.
K50	Human Resources Administration and Development Bureau	Reliability	Health services are available and well-socialized.
K51	Human Resources Administration and Development Bureau	Responsiveness	Health services are handled by reliable medical personnel (doctors).
K52	Human Resources Administration and Development Bureau	Tangible	Health service staff are polite courteous and friendly.
K53	Professional Certification Institute	Assurance	Professional Certification Institute service staff are knowledgeable and transparent in providing services.
K54	Professional Certification Institute	Empathy	Professional Certification Institute service staff are polite courteous and friendly.
K55	Professional Certification Institute	Reliability	Procedures and information systems for Professional Certification Institute services are clear and reliable.
K56	Professional Certification Institute	Responsiveness	Professional Certification Institute service staff provide services quickly and responsively.
K57	Professional Certification Institute	Tangible	Professional Certification Institute services have complete facilities and infrastructure and a complaint channel is available.
K58	Student Admission Bureau	Assurance	Student admission service staff are knowledgeable and transparent in providing services.
K59	Student Admission Bureau	Empathy	Student admission service staff are polite courteous and friendly.
K60	Student Admission Bureau	Reliability	Procedures and information systems for student admission services are clear and reliable.
K61	Student Admission Bureau	Responsiveness	Student admission service staff provide services quickly and responsively.
K62	Student Admission Bureau	Tangible	Student admission services have complete facilities and infrastructure and a complaint channel is available.
K63	Library Bureau	Assurance	Library staff are knowledgeable and transparent in providing services.
K64	Library Bureau	Empathy	Library staff are polite courteous and friendly.
K65	Library Bureau	Reliability	The library has clear and easy service procedures.
K66	Library Bureau	Responsiveness	Library staff provide services quickly and responsively.
K67	Library Bureau	Tangible	The library meets the availability of mandatory and reference books used in the teaching-learning process.
K68	Facilities and Infrastructure Bureau	Assurance	Facilities and infrastructure service staff are knowledgeable and transparent in providing services.
K69	Facilities and Infrastructure Bureau	Empathy	Facilities and infrastructure service staff are polite courteous and friendly.
K70	Facilities and Infrastructure Bureau	Reliability	Facilities and infrastructure services have clear and easy service procedures.
K71	Facilities and Infrastructure Bureau	Responsiveness	Facilities and infrastructure service staff provide services quickly and responsively.
K72	Facilities and Infrastructure Bureau	Tangible	Facilities and infrastructure services provide classrooms with lighting and audiovisual facilities.
K73	Facilities and Infrastructure Bureau	Tangible	Facilities and infrastructure services provide well членов

Code	Category	Subcategory	Description
K74	Facilities and Infrastructure Bureau	Tangible	Facilities and infrastructure services provide clean and comfortable restrooms places of worship and available parking.
K75	Management Services	Assurance	In carrying out each main task and function guidance and direction from management are provided quickly and appropriately.
K76	Management Services	Empathy	Leaders and/or authorized personnel are knowledgeable and transparent in supporting the implementation of main tasks and functions.
K77	Management Services	Reliability	Management services at UMB are carried out professionally in accordance with procedures.
K78	Management Services	Responsiveness	Availability of service procedures to support main tasks and functions administration and information needs services.
K79	Management Services	Tangible	Information facilities and infrastructure to support activities in accordance with job descriptions and main tasks and functions.

the second is an evaluation of lecturer teaching quality, as shown in Table 2, comprising 2,163 records. All data were provided in Excel (.xlsx) format, making them suitable for structured analysis using statistical and machine learning methods.

Table 2. Teaching Dataset

Code	Satisfaction Dimension	Subdimension	Description
K01	Responsiveness		Lecturers are willing to assist students in solving problems and responding to questions and comments.
K02	Assurance		Lecturers master the material provided and are fair and impartial in grading.
K03	Empathy		Lecturers care and motivate students to do their best.
K04	Reliability		Lecturers deliver material and assessments consistently openly and systematically.
K05	Tangible	System	The online lecture system is fast and easily accessible.
K06	Tangible	Material	Lecturers inform about lecture regulations and provide sufficient teaching materials.
K07	Tangible	Facility	Availability of classroom facilities such as computers internet microphones AC markers and projectors.

The second dataset focuses on evaluating lecturer teaching quality, as shown in Table 2, and consists of 2,163 student response records. The data, provided in Excel (.xlsx) format, were directly imported into Orange using the "File" widget for further analysis. Orange's visual programming interface allowed for easy preprocessing, clustering, and classification workflows. Teaching evaluation attributes were analysed to identify trends, group patterns using K-Means, and extract decision rules via the Decision Tree model. This approach enabled a clear understanding of which aspects of teaching most influence student satisfaction, providing actionable insights to improve academic service quality at the university.

Data Preparation

Before analysis, the dataset underwent a data cleaning process, which included removing duplicate entries and handling missing values to ensure data quality. If necessary, normalization

was applied to standardize the value scale across different attributes. The data attributes were then grouped into two main categories: the academic environment and Teaching. After preprocessing, the cleaned and structured data were stored in Excel (.xlsx) format. This format allows seamless integration with the Orange data mining tool, where the dataset can be imported directly using the "File" widget for further analysis and modelling.

Before applying Clustering and Decision Tree algorithms, the correlation between each variable was examined to understand the relationships between indicators (F. Rianda,2022), (R. S. Sihombing, 2023) within both the service and lecturer teaching datasets.

Table 3. the academic environment Satisfaction Correlation

Rank	Correlation	Indicator 1	Indicator 2
1	0.972	K23	K25
2	0.97	K26	K27
3	0.969	K39	K40
4	0.969	K18	K22
5	0.968	K40	K41
6	0.968	K18	K20
7	0.968	K38	K40
8	0.968	K48	K49
9	0.967	K21	K22
10	0.967	K49	K51

The analysis of postgraduate (S2 MM) student satisfaction at UMB, using questionnaire data from the User Satisfaction Bureau, identified the top 10 highest-rated indicators from both service and teaching domains. K01 (academic atmosphere) and K04 (diversity and inclusion) reflected a supportive and empathetic learning environment. K07 (lecturers' subject mastery and fair grading) stood out for assurance, indicating academic trust. In career services, K18 (transparency of staff) showed high reliability and strong correlation with K22 (+0.969). Financial service indicators K23 and K25 had the strongest correlation (+0.972), highlighting transparency and competence. K26 (empathy) also correlated strongly with K27 (+0.970), showing the value of staff friendliness. Student affairs indicators like K39, K40, and K41 emphasized clarity, responsiveness, and empathy, each strongly interrelated (correlations ~+0.969). Lastly, K48 (health staff competence) and K49 reinforced the importance of trustworthy health services. These results offer a clear foundation for strategic improvements in service quality and teaching effectiveness across the university.

Tabel 4. Teaching Correlation

Rank	Value	Indicator 1	Indicator 2
1	-0.924	K02	K03
2	-0.916	K03	K04
3	-0.904	K01	K04
4	-0.902	K01	K03
5	-0.899	K02	K04
6	-0.892	K01	K02
7	-0.88	K01	K06
8	-0.878	K04	K06
9	-0.878	K03	K06
10	-0.874	K02	K06

The correlation analysis of postgraduate (S2 MM) student satisfaction at UMB on lecturer teaching quality (K01–K07) revealed strong interrelationships among key indicators, with the highest correlation of +0.924 between K02 (lecturer's mastery and fairness) and K03 (empathy), indicating that competent lecturers tend to be more caring and motivating. Other notable correlations included K03 with K04 (consistency, +0.916), and K01 (responsiveness) with both K04 (+0.904) and K03 (+0.902), suggesting that responsive lecturers often deliver structured and supportive teaching. Additional strong links were found between K02 and K04 (+0.899), K01 and K02 (+0.892), and K01 with K06 (availability of materials, +0.880), confirming that lecturer competence and availability contribute to better access to learning resources. Furthermore, correlations among K04, K03, and K06 (each above +0.87) highlighted the alignment between empathy, teaching consistency, and material readiness. Overall, these findings underscore that responsiveness, empathy, and consistency are essential qualities that significantly influence postgraduate student satisfaction and should be prioritized to enhance teaching effectiveness.

Modeling

Clustering was performed as a segmentation process using the K-Means algorithm to group students based on similarities in their responses and evaluation patterns related to the academic environment and teaching quality. The main objective of this segmentation was to identify distinct groups of students with similar satisfaction levels. These clusters help reveal patterns in student perceptions that may not be apparent through basic analysis. Following the clustering phase, a classification model was developed using the Decision Tree algorithm to determine which variables had the most influence on cluster formation. The Decision Tree approach was selected due to its ability to produce clear, interpretable rules that explain student groupings. This combination of unsupervised and supervised learning techniques enables both discovery of natural student segments and understanding of the key factors driving satisfaction. The results can be used to guide targeted interventions for service and instructional improvements within the university.

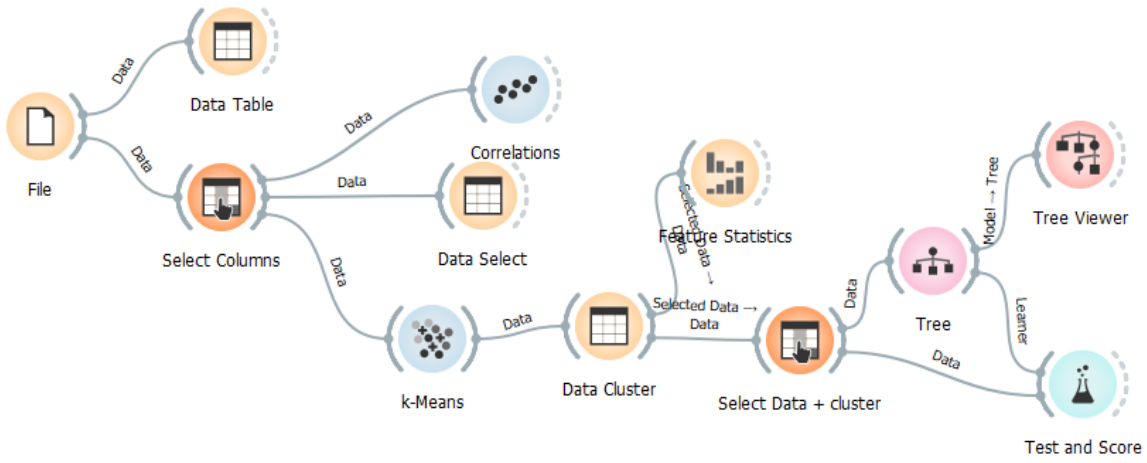

Figure 2. The Academic Environment and Teaching Modelling

In the Modelling stage to evaluate student satisfaction with services and teaching quality at UMB, the analysis was conducted using a workflow based on Orange (BSI News.,2024), (Fakultas Ilmu Komputer Universitas Brawijaya,2024),(A.Zubair.,2022) , a Python-based visual programming platform. The algorithms used were K-Means and Decision Tree to identify and interpret satisfaction patterns, as shown in Figure 2.

The process began with the Business Understanding phase for services (K01–K79), aiming to evaluate the satisfaction levels of postgraduate (S2 MM) students at UMB regarding

academic aspects, facilities, and administrative services. The questionnaire items were grouped into several categories based on service areas: Academic Atmosphere (K01–K05), which includes the conduciveness of academic activities, scientific events, educational staff services, diversity, and infrastructure; Learning (K06–K12), focusing on lecturers' teaching quality; Entrepreneurship Bureau (K13–K17), covering entrepreneurial support; Career Bureau (K18–K22), relating to career guidance services; Finance Administration Bureau (K23–K27), addressing financial services; Academic Operations Bureau (K28–K32), which includes academic administrative functions; Student Affairs Bureau (K33–K47), focusing on scholarships, counselling, and student talents/interests; HR and Administration Bureau (K48–K52), providing health services; Professional Certification Agency (K53–K57), regarding professional certification; Admissions Bureau (K58–K62), dealing with student admissions; Library Bureau (K63–K67), concerning library services; Facilities and Infrastructure Bureau (K68–K74), addressing the availability and quality of physical facilities; and Management Services (K75–K79), focusing on the professionalism of university management services.

These dimensions were analysed through the lens of responsiveness, assurance, empathy, reliability, and tangibility. For teaching evaluation (K01–K07), the focus was on teaching quality and the academic atmosphere using indicators such as academic conduciveness, diversity, facilities, lecturer responsiveness, and subject mastery—to improve both learning and the academic environment. To capture all indicators (K01–K79 for services and K01–K07 for teaching), the Modelling process began with the File widget to import a clean dataset, followed by Select Columns to choose the relevant indicators. These were then displayed using the Data Table widget.

The Correlations widget analysed inter-variable relationships, followed by Feature Statistics to calculate basic statistics such as average satisfaction per category. Then, K-Means was applied to cluster students based on satisfaction levels (Very Satisfied, Satisfied, Dissatisfied), with results shown in a Data Table. The clustered data was filtered again using Select Data for key indicators, and a Decision Tree model was built using the Tree widget to identify patterns, which were visualized using the Tree Viewer. This supported actionable insights and recommendations for improving service and teaching quality. The final step involved evaluating accuracy, recall, precision, and AUC using the Test and Score widget.

The K-Means segmentation produced three clusters representing student satisfaction levels in the UMB Master of Management Program: C1 (Very Satisfied, 473 respondents), C2 (Satisfied, 538), and C3 (Dissatisfied, 159). From 1,170 total responses, most students were Satisfied (45.98%), followed by Very Satisfied (40.43%), and Dissatisfied (13.59%). These findings suggest that the academic environment and teaching quality are generally positive, though the dissatisfied group still needs focused attention.

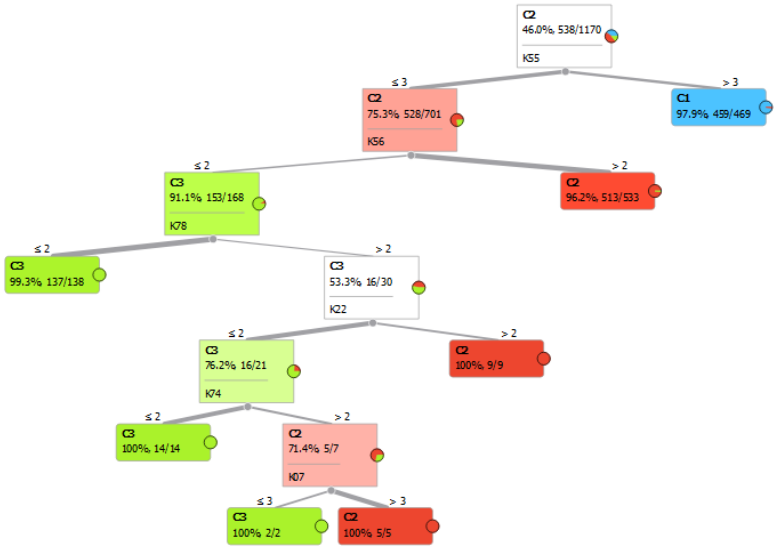

Figure 3. Decision Tree for The Academic Environment

The classification analysis using the Decision Tree method (Figure 3) aimed to identify key attributes influencing student satisfaction levels in the UMB Master of Management Program. The decision tree began with the most significant variable, K55 (clarity and reliability of procedures and information systems at the Professional Certification Institute). If K55 was rated above 3, 97.9% of respondents fell into the Very Satisfied (C1) cluster. If rated 3 or below, responses largely shifted to the Satisfied (C2) cluster. Following this, K56 (responsiveness of the Professional Certification Institute) became the next significant variable, where scores above 2 led to 96.2% of responses being classified as Satisfied (C2).

For the Dissatisfied (C3) cluster, the most decisive attributes were K78 (responsiveness of Management Services) and K22 (tangible aspects of the Career and Alumni Bureau). If both were rated 2 or below, there was a 99.3% likelihood of being classified into the C3 cluster. Additional contributing attributes to dissatisfaction included K74 (facilities), K07 (assurance in teaching), and K02/K04 (academic atmosphere and scientific activities). These results show that negative experiences in managerial responsiveness and poor physical infrastructure strongly correlate with dissatisfaction.

From these insights, strategic actions to improve student satisfaction should focus on: (1) enhancing the clarity and efficiency of certification procedures and career services, (2) improving student management and responsiveness, and (3) upgrading campus physical infrastructure like restrooms, parking, and places of worship. Overall, the Decision Tree model successfully reveals key patterns in student sentiment and serves as a robust foundation for targeted quality improvements in postgraduate education at UMB.

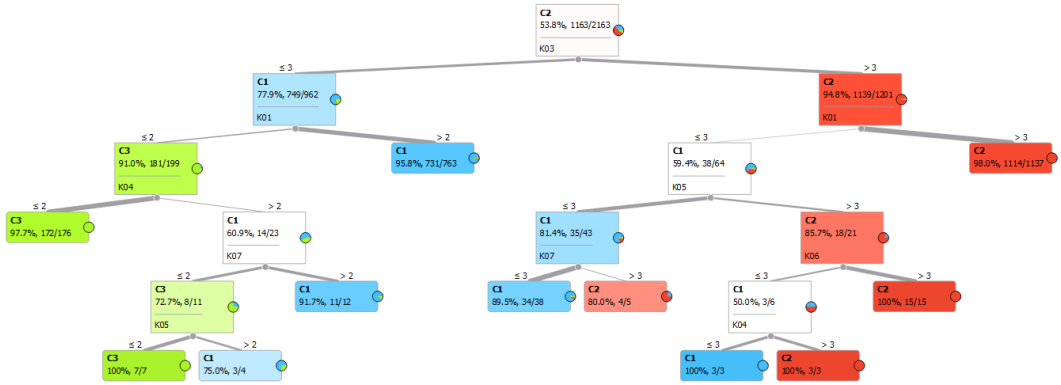

Table 4. Teaching Correlation

Figure 4is an analysis of student satisfaction regarding lecturer teaching quality using the Decision Tree method categorized 2,163 postgraduate students into three levels: Very Satisfied (1,163 or 53.77%), Satisfied (810 or 37.43%), and Dissatisfied (190 or 8.79%). These results indicate that, overall, students in the Master of Management Program at UMB perceive their lecturers very positively, with the majority falling into the Very Satisfied group.

The root node of the decision tree is Lecturer Empathy (K03), showing it is the most influential factor in differentiating satisfaction levels. Students scoring K03 > 3 are mostly classified as Very Satisfied (C2), especially when supported by high scores in Responsiveness (K01) and Reliability (K04), with classification accuracy reaching up to 100%. In contrast, students with K03 ≤ 3, K01 ≤ 2, and K04 ≤ 2 are likely to fall into the Dissatisfied (C3) group (97.7% accuracy). The Satisfied (C1) category typically appears in more moderate combinations, such as K03 ≤ 3 and K01 > 2, with additional influence from variables like Facilities (K07) and Online Systems (K05).

These findings highlight Empathy (K03) and Responsiveness (K01) as the most critical factors influencing student satisfaction, either positively (toward Very Satisfied) or negatively (toward Dissatisfied). Other supporting variables such as Reliability (K04), Learning Materials (K06), and Academic Facilities (K05, K07) also contribute significantly to classification. Based on these insights, it is recommended to: (1) enhance lecturer training programs focusing on empathy and responsive communication; (2) regularly monitor academic systems and physical facilities; and (3) integrate Empathy and Responsiveness as core indicators in lecturer performance evaluations.

Evaluation

The interpretation of clustering results focused on identifying how many distinct student clusters were formed and analysing the characteristics of each cluster in terms of satisfaction with the academic environment and teaching quality. Each group represents a segment with unique patterns and preferences, providing valuable insights into different student experiences. After clustering, the Decision Tree model was evaluated to assess its classification accuracy and the clarity of the rules it generated. These rules were interpreted through the lens of Human Resource management to understand how various factors, such as learning environment, lecturer performance, or administrative support, influence student satisfaction. The analysis aimed to uncover dominant attributes that play a key role in classifying students into specific satisfaction groups. This understanding allows university administrators and HR managers to develop more targeted strategies for improvement, focusing on what matters most to each student segment and thereby enhancing overall service and educational quality.

The Evaluation stage assessed the results of the Modelling process regarding postgraduate (S2 MM) student satisfaction with services (K01–K79) and teaching (K01–K07) at UMB. This

was grounded in the Business Understanding objective: to enhance services and teaching based on the five dimensions (responsiveness, assurance, empathy, reliability, tangibility). The Data Understanding stage involved extracting indicators K01–K79 and K01–K07 from the User Satisfaction Bureau.

The Modelling used K-Means to classify students into clusters: Very Satisfied, Satisfied, and Dissatisfied, followed by a Decision Tree to identify patterns such as low lecturer responsiveness and inadequate internet facilities in the Dissatisfied cluster.

The evaluation revealed three distinct clusters of student satisfaction. The Very Satisfied cluster was characterized by a conducive academic atmosphere and strong lecturer content mastery. The Satisfied cluster reflected generally adequate facilities, although there were variations in service responsiveness across units. In contrast, the Dissatisfied cluster was primarily influenced by weaknesses in certain administrative services and the poor condition of campus infrastructure. These findings highlight specific areas that contribute to differing levels of student satisfaction and can inform targeted improvements. Recommended improvements include lecturer responsiveness training, online system optimization, and better facilities.

Table 5. Decision Tree Evaluation Results

Aspect	AUC	CA	F1 Score	Precision	Recall
The Academic Environment	0.957	0.944	0.944	0.944	0.944
Lecture Teacing	0.951	0.946	0.946	0.946	0.946

The Decision Tree model was assessed across two key areas: *Academic Services* and *Lecturer Teaching Performance*, using five evaluation metrics—AUC (Area Under the Curve), Classification Accuracy (CA), F1 Score, Precision, and Recall. The results demonstrate that the model performs exceptionally well in predicting student satisfaction levels.

For *Academic Services*, the model achieved its highest metrics with an AUC of 0.957, signifying excellent ability to distinguish between satisfaction categories. It also scored 0.944 in CA, F1 Score, Precision, and Recall indicating both high accuracy and a well-balanced sensitivity-to-precision ratio. Meanwhile, in the *Lecturer Teaching* category, the model also performed strongly, recording an AUC of 0.951 and 0.946 across CA, F1 Score, Precision, and Recall. Although slightly lower than Academic Services, these results still reflect a high degree of reliability.

Overall, the Decision Tree model proves to be a robust and effective analytical tool for classifying and understanding student satisfaction. Its high performance in both service and teaching categories supports its practical use in guiding improvements in academic quality and administrative support within postgraduate education.

Deployment

The analysis results were used to develop a set of recommendation reports aimed at supporting campus decision-making. These recommendations specifically focus on aspects that students rated poorly, based on the clustering and classification findings. By identifying which facility and teaching elements need the most improvement, the reports offer targeted, data-driven suggestions for enhancing student satisfaction. These insights can help campus management prioritize actions, allocate resources more effectively, and implement improvements that align with the real needs and expectations of students.

The Deployment stage in this study of postgraduate (S2 MM) student satisfaction at UMB, focusing on services (K01–K79) and teaching (K01–K07), was structured as a presentation to stakeholders specifically the User Satisfaction Bureau and related university

units. The aim was to deliver data-driven insights to support future decision-making. Following the Business Understanding framework, the study's objective was to improve services and teaching through the five core dimensions. Data indicators were sourced from the User Satisfaction Bureau (K01–K79 and K01–K07).

K-Means was applied to classify student satisfaction into three clusters: Very Satisfied, Satisfied, and Dissatisfied. Following the clustering process, a Decision Tree model was used to identify influential patterns and attributes within each group. For instance, low lecturer responsiveness (K06) and poor internet facilities (K05) emerged as dominant factors within the Dissatisfied cluster. During the evaluation phase, the Very Satisfied cluster was found to be associated with a conducive academic environment (K01) and strong lecturer subject mastery (K07). The Satisfied cluster showed generally adequate facilities (e.g., K05, K07), but revealed inconsistency in service responsiveness. Meanwhile, the Dissatisfied cluster was primarily influenced by deficiencies in administrative services particularly those handled by the Finance Administration Bureau (K23–K27) as well as issues related to poor infrastructure. These insights provide actionable direction for targeted improvements across academic and administrative domains to enhance overall student satisfaction.

In the Deployment phase, the presentation emphasized several key findings derived from the analysis. First, there is a clear need for lecturer responsiveness training to improve interaction and engagement, particularly related to indicator K06. Second, the optimization of the online academic system (K05) was highlighted as essential for enhancing tangibility and accessibility of services. Third, improvements in infrastructure, including internet connectivity and classroom conditions (K05, K07), were deemed critical to support a more conducive learning environment. Lastly, the findings underscored the importance of strengthening administrative services, especially in areas identified within the Dissatisfied cluster, to address student concerns effectively. These targeted recommendations are expected to support strategic improvements in both academic and operational aspects of the university. The study recommended that stakeholders develop an action plan, allocate a budget, create an implementation timeline, and schedule a re-evaluation within six months to monitor the impact of improvements on student satisfaction.

The deployment stage of this student satisfaction analysis focused on graduate students of the Master of Management Program at UMB, evaluating both service quality (K01–K79) and lecturer teaching performance (K01–K07). A comprehensive presentation was prepared for the User Satisfaction Bureau, aiming to deliver actionable insights to support strategic improvements. Guided by the SERVQUAL dimensions Responsiveness, Assurance, Empathy, Reliability, and Tangibles the process followed standard CRISP-DM stages: understanding the business goals, collecting satisfaction indicators, and building models to explore patterns and issues in student experience.

Data was collected from the User Satisfaction Bureau's internal system. In the modeling phase, the K-Means algorithm grouped responses into three clusters: Very Satisfied, Satisfied, and Dissatisfied. Decision Tree analysis then identified key attributes linked to each cluster. For example, low lecturer responsiveness (K06) and inadequate internet access (K05) were strongly associated with the Dissatisfied group. In contrast, high satisfaction levels correlated with conducive learning environments (K01) and strong subject mastery from lecturers (K07), while moderate satisfaction was often linked to adequate but inconsistent facilities and responsiveness.

The Very Satisfied cluster was driven by inclusive academic environments and highly competent lecturers. The Satisfied group appreciated sufficient physical facilities (K05, K07), but noted inconsistencies in service speed and responsiveness. Meanwhile, the Dissatisfied cluster revealed underlying issues such as delayed services in certain bureaus (K23–K27) and weak digital infrastructure. These patterns provide valuable insights into what factors most

influence different satisfaction levels, giving decision-makers a clearer view of areas needing attention.

To enhance student satisfaction, the study recommends improving lecturer responsiveness through targeted training, optimizing online academic systems for better service delivery, and upgrading technology infrastructure such as internet connectivity and classroom equipment. Strategic planning should include clear budget allocation and scheduling a re-evaluation within six months to monitor progress and ensure continuous improvement in the quality of education and support services.

CONCLUSION

This study on graduate student satisfaction in UMB's Master of Management program reveals that high satisfaction levels are primarily driven by a supportive academic environment (K01), sufficient infrastructure (K05), and strong lecturer competencies, particularly subject mastery (K07) and fairness in assessment (K02). These findings suggest that students value not only the physical and academic aspects of their learning environment but also the professionalism and credibility of their lecturers. However, lower satisfaction was linked to issues in technological infrastructure—especially internet access and online systems—and slow responsiveness in certain administrative bureaus (K23–K27), highlighting the need for targeted improvements in these areas.

Furthermore, lecturer performance remains a crucial factor in shaping student perceptions. While many students recognize their lecturers' expertise, aspects such as responsiveness (K06) and consistency in delivering learning experiences (K04) require enhancement. To address these concerns, it is recommended that the university invest in lecturer training programs, upgrade digital and classroom infrastructure, and establish regular evaluation mechanisms. By integrating student feedback into curriculum development and academic services, UMB can strengthen its educational quality and sustain high levels of satisfaction among postgraduate students.

REFERENCE

A. Utkirov, "Servqual as a Tool for Measuring and Enhancing Higher Education Service Quality," Manag. Mark. Finance Int. Sci. J., vol. 1, no. 4, pp. 153–157, 2024, doi: 10.5281/zenodo.14195564.

A. F. Alamsyah, "Pengaruh Kualitas Pelayanan Administrasi Keuangan Terhadap Tingkat Kepuasan Mahasiswa di Universitas Banten Jaya," Prog. J. Ilm. Ilmu Adm., vol. 2, no. 1, 2023, [Online]. Available: https://ejournal.lppm-unbaja.ac.id/index.php/progress/article/view/2502

A. Kurbani, "Pengaruh Kualitas Layanan Akademik dan Fasilitas Pendidikan Terhadap Kepuasan Mahasiswa," J. Ekon., vol. 22, 2022, [Online]. Available: https://jurnal.univpgri-palembang.ac.id/index.php/Ekonomika/article/download/2701/2512

A. K. Siregar, "Pelayanan Administrasi Akademik Mahasiswa di Biro Akademik UIN Ar-Raniry Banda Aceh," Intel J. Ilm. Ilmu Pendidik., vol. 1, no. 1, 2022, [Online]. Available: https://jurnal.ar-raniry.ac.id/index.php/intel/article/download/10665/5923

A. R. Siregar, "Bimbingan dan Konseling Karir di Perguruan Tinggi," Mauizhah J. Pendidik. Agama Islam, vol. 1, no. 1, 2020, [Online]. Available: https://ojs.stit-syekhburhanuddin.ac.id/index.php/mauizhah/article/download/52/50

A. Ristha, "Analisis Kepuasan Pelanggan Menggunakan Metode Servqual dan Fuzzy di Badan Perpustakaan dan Arsip Yogyakarta (BAD DIY)," Master's Thesis, UIN Sunan Kalijaga Yogyakarta, 2016. [Online]. Available: https://digilib.uin-suka.ac.id/id/eprint/20023

A. Zubair, Data Mining Menggunakan Orange. Jakarta: UPN Veteran Jakarta, 2022.

Azis, A., Mahendrati, G., Azizah, I. N., Cahya Utami, R., Guru, P., & Dasar, S. (n.d.). Perbandingan suasana akademik pada program pertukaran pelajar UNS-UNY. 2023

BSI News, "Pelatihan Data Mining: Optimalisasi Kualitas Penelitian Dosen Universitas BSI dengan Orange." 2024.

Cazacu, M., & Titan, E. (2020). Adapting CRISP-DM for Social Sciences. BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 11(2sup1), 99–106. https://doi.org/10.18662/brain/11.2Sup1/97

Fakultas Ilmu Komputer Universitas Brawijaya, "FILKOM UB Adakan Mini Lecture 'Clustering Theory and Application using Orange Data Mining.'" 2024.

F. Bassi, "Dynamic Clustering to Evaluate Satisfaction with Teaching at University," Univ. Padua, 2018.

F. Rianda, "Penerapan Algoritma K-Means dan K-Medoids dalam Pengelompokan Provinsi di Indonesia Berdasarkan Indikator Perumahan Rumah Tangga," J. Estimasi, vol. 2, no. 1, pp. 101–105, 2022.

Foropon, C., Seiple, R., & Kerbache, L. (2013). Using Servqual to Examine Service Quality in the Classroom: Analyses of Undergraduate and Executive Education Operations Management Courses. International Journal of Business and Management, 8(20). https://doi.org/10.5539/ijbm.v8n20p105

Hidayati, N., Irma Rizmayanti, A., Bunga Sari Dewi, C., Fatmasari, R., Gata, W., Nusa Mandiri, S., Kunci, K., & Kepentingan, T. (2020). Penerapan Algoritma Klasterisasi dan Klasifikasi pada Tingkat Kepentingan Sistem Pembelajaran di Universitas Terbuka. In JURNAL SWABUMI (Vol. 8, Issue 2).

Jia, S., & Pang, Y. (2018). Teaching quality evaluation and scheme prediction model based on improved decision tree algorithm. International Journal of Emerging Technologies in Learning, 13(10), 146–157. https://doi.org/10.3991/ijet.v13i10.9460

Kadafi, A., & Gata, W. (2019, December 2). Particle Swarm Optimization Based C4.5 for Teacher Performance Classification. https://doi.org/10.4108/eai.18-7-2019.2288586

Kurniah, R., Surya Putra, D. Y., & Diana, E. (2022). Penerapan Data Mining Decission Tree Algoritma C4.5 Untuk Mengetahui Tingkat Kepuasan Mahasiswa Terhadap Layanan Akademik Dan Kemahasiswaan (Studi Kasus Universitas.Prof.Dr. Hazairin,SH). Infotek: Jurnal Informatika Dan Teknologi, 5(2), 316–326. https://doi.org/10.29408/jit.v5i2.5910

M. A. López-Cueva and others, "Experience Using Decision Trees and Logistic Regression: A Comparative Analysis," Univ. Nac. Altiplano, 2024.

Manunggal, B., & Afriadi, B. (n.d.). Servqual In Higher Education Institutions. In International Journal of Business (Vol. 4, Issue 1). 2023

Pelatihan Pemanfaatan Teknologi Chatgpt Untuk Surat Menyurat Kader Pkk Desa Cimulang Bogor. Jurnal AbdiMas Nusa Mandiri, 6(1), 55–60. https://doi.org/10.33480/abdimas.v6i1.5514

Matzavela, V., & Alepis, E. (2021). Decision tree learning through a Predictive Model for Student Academic Performance in Intelligent M-Learning environments. Computers and Education: Artificial Intelligence, 2. https://doi.org/10.1016/j.caeai.2021.100035

Martínez-Plumed, F., Contreras-Ochando, L., Esar Ferri, C. `, Jos´, J., Hernándezhern´hernández-Orallo, J., Kull, M., Lachiche, N., Jos´, M. J., Ramírez-Quintana, J., & Flach, P. (n.d.). CRISP-DM Twenty Years Later: From Data Mining Processes to Data Science Trajectories. https://www.kdnuggets.com/

Pandey, M., & Kumar Sharma, V. (2013). A Decision Tree Algorithm Pertaining to the Student Performance Analysis and Prediction. International Journal of Computer Applications, 61(13), 1–5. https://doi.org/10.

Ramadhani, N. T., & Nurnida, I. (2017). Pengaruh Mata Kuliah Kewirausahaan Terhadap Minat Berwirausaha Mahasiswa. Jurnal Ecodemica, 1(1).

Ruang Jurnal, "Efektivitas Pembelajaran Online di Pendidikan Tinggi: Tinjauan dari Sudut Pandang Mahasiswa," Ruang J., 2022, [Online]. Available: https://ruangjurnal.com/100-contoh-judul-jurnal-sinta-2-tentang-pembelajaran-2/

R. Syaputri and B. Hartono, "Manajemen Sumber Daya Manusia di Bidang Pelayanan Kesehatan," Komunika J. Ilm. Komun., vol. 1, no. 1, 2025, [Online]. Available: https://publikasi.abidan.org/index.php/komunika/article/download/78/80/3713

R. S. Sihombing, "Analisis Klaster Negara Berdasarkan Indikator Sosial-Ekonomi Menggunakan Algoritma Fuzzy C-Means dan K-Means," J. Rekursif, vol. 8, no. 2, pp. 123–130, 2023.

Rohman, A., & Wibowo, A. (n.d.). Prediksi Kepuasan Mahasiswa Terhadap Layanan Akademik Dalam Program MBKM Menggunakan Algoritme C4.5.

Sarofah, I., Satyarini, M. D., & Setyaningsih, S. (2021). Strategi Penerimaan Mahasiswa Baru Pada Masa Pandemi Covid-19 di Universitas Ivet Semarang. Journal of Economic Education and Entrepreneurship, 2(2), 62. https://doi.org/10.31331/jeee.v2i2.1924

S. Karomah, S. Hadi, N. A. E. Fatria, and A. L. Kamalia, "Persepsi Mahasiswa terhadap Lembaga Sertifikasi Profesi: Kajian Upaya Meningkatkan Mutu Profesional," J. Pendidik. Ris. Dan Konseptual, vol. 7, no. 2, 2023, doi: 10.28926/riset_konseptual.v7i2.714.

S. Moro, P. Cortez, and R. M. S. Laureano, "Using Data Mining for Bank Direct Marketing: An Application of the CRISP-DM Methodology," Expert Syst. Appl., vol. 39, no. 11, pp. 9290–9296, 2011

T. S. Purba, Pedoman Layanan Kemahasiswaan. Sekolah Tinggi Ilmu Administrasi Pelita Nusantara, 2023. [Online]. Available: https://siborang.stiapen.ac.id/wp-content/uploads/2023/07/PEDOMAN-LAYANAN-KEMAHASISWAAN.pdf

Fathurrahman, M., DPW, I. A., Mursito, B., "Pengaruh Kualitas Layanan Manajemen terhadap Prestasi Belajar melalui Kepuasan Mahasiswa di Institut Islam Mamba'ul 'Ulum Surakarta," J. Muqtasid, 2023, [Online]. Available: https://jurnal.iimsurakarta.ac.id/index.php/mu/article/view/369/255

Wardhani, N. K., & Gata, W. (2018). E-Learning Evaluation Using PIECES Framework at Mercubuana University.

W. S. Kim, "A Study on Factors of Education's Outcome using Decision Trees," PhD Thesis, Baird University College, Soongsil University, Korea, 2016.