A Systematic Review on Machine Learning Algorithms for Customer Satisfaction Classification in Various Fields

Priyadarshini P. [1] & K. T. Veeramanju [2]
[1] Research Scholar, Institute of Computer Science and Information Science, Srinivas University, Mangalore – 575001, Karnataka India,
ORCIDID: 0000-0003-4658-3742; Email: priyadarshini.pnair@gmail.com
[2] Research Professor, Institute of Computer Science and Information Science, Srinivas University, Mangalore – 575001, Karnataka India,
ORCIDID: 0000-0002-7869-3914; Email: veeramanju.icis@srinivasuniversity.edu.in

Area/Section: Computer Science.
Type of the Paper: Literature Review.
Type of Review: Peer Reviewed as per |C|O|P|E| guidance.
Indexed in: OpenAIRE.
DOI: https://doi.org/10.5281/zenodo.8316364
Google Scholar Citation: IJMTS

How to Cite this Paper:
Priyadarshini, P., & Veeramanju, K. T. (2023). A Systematic Review on Machine Learning Algorithms for Customer Satisfaction Classification in Various Fields. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *8*(3), 326-339. DOI: https://doi.org/10.5281/zenodo.8316364

International Journal of Management, Technology, and Social Sciences (IJMTS)
A Refereed International Journal of Srinivas University, India.

CrossRef DOI: https://doi.org/10.47992/IJMTS.2581.6012.0305

Received on: 12/08/2023
Published on: 04/09/2023

A Systematic Review on Machine Learning Algorithms for Customer Satisfaction Classification in Various Fields

Priyadarshini P. [1] & K. T. Veeramanju [2]
[1] Research Scholar, Institute of Computer Science and Information Science, Srinivas University, Mangalore – 575001, Karnataka India,
ORCIDID: 0000-0003-4658-3742; Email: priyadarshini.pnair@gmail.com
[2] Research Professor, Institute of Computer Science and Information Science, Srinivas University, Mangalore – 575001, Karnataka India,
ORCIDID: 0000-0002-7869-3914; Email: veeramanju.icis@srinivasuniversity.edu.in

ABSTRACT

Purpose: *A variety of soft approaches have already been considered in relation to the growth of marketing. Problems related to customer satisfaction and retention have been studied earlier. The application of business intelligence, artificial intelligence, and data mining has a great impact on the development of business organizations. Customers are increasing day by day in every field, which is complicating the method of finding their satisfaction level. To find the best method to solve these complexities, advanced machine learning approaches can be used. This paper discusses a detailed literature survey of various approaches used to identify customer satisfaction and retention using customer logs in various fields.*
Design/Methodology/Approach: The details collected for this review paper were obtained by analysing and comparing different research articles from recognized resources.
Objective: *To find a research gap and appropriate solutions for customer satisfaction accuracy using machine learning approaches.*
Results/ Findings: *Review of this paper gives a proper understanding of customer satisfaction in various domains using machine-learning approaches*
Originality/Value: *The review of this paper gives an analysis of machine learning algorithms for customer satisfaction in various fields and suggests the importance of new classification models.*
Type of Paper: *Literature Review.*
Keywords: customer retention, customer satisfaction, machine learning, data mining, recommendation, student satisfaction, classification algorithms.

1. INTRODUCTION :

A modern business' success depends on its ability to satisfy its customers. Predicting client pleasure so becomes a crucial business intelligence objective (Xiao, G. et al. (2022). [1]). Business organizations must work hard in this competitive age to keep existing consumers satisfied as well as attract new ones (Johny, C.P. et al. (2017). [2]). Many various sorts of businesses have started taking consumer happiness into account, including the hotel industry, hospitals, e-commerce, banking sector, education, public sector, airline industry, etc. The main purpose of measuring customer satisfaction is to determine how effectively a company satisfies its customers' requirements and what could be improved (Pizam, A. et al. (2016). [3]). The customer essentially compares a good or service before and after making a purchase or taking the service (Paul, J., Mittal, A., et al. (2016). [4], Kant, R. et al. (2017). [5], Hui, E. C. M. et al. (2010). [6]).
Customer satisfaction in the hotel industry is connected with seven criteria relating to guests' hotel experiences. Customer loyalty is also influenced by all of these variables including customer pleasure (El-Adly, M. I. (2019). [7]). Text analysis is used in the banking sector to predict client satisfaction. In the article, chat data that were gathered while conducting banking transactions are evaluated. The findings of this study will assist banks in increasing customer satisfaction (Hristova, G. (2022). [8]). The field of railway transport also uses the measurement of customer satisfaction. In the survey, information on two level qualities is gathered (Chakraborty, S.et al.(2016). [9]). Based on the analysis of the data gathered from Twitter, a report on the forecast of airline consumer satisfaction was produced

(S. Kumar, et al. (2019). [10]). This paper investigates a detailed literature review of customer satisfaction using various algorithms, mainly in the education sector

2. OBJECTIVES OF REVIEW PAPER :

(1) Analysis of customer satisfaction and retention
(2) To understand various machine learning algorithms used in business organizations for their growth
(3) Comparison of existing models to predict customer satisfaction.
(4) To propose the research gap and solutions to reduce the gap.
(5) ABCD analysis of machine learning approaches for customer satisfaction.

3. METHODOLOGY :

The analysis is based on data gathered from a variety of sources, including academic journals, conference papers, websites, and publications.

4. REVIEW OF LITERATURE/ RELATED WORKS :

4.1 Role of Customer Satisfaction:

Customer retention is the ability of a business to keep customers as repeat customers and keep them from switching to a competitor. It refers to the quality of your offering and the level of satisfaction your current clients have with your services. Acquiring new customers is difficult and expensive for any business organization, so it's very important to retain the existing customer base. Systems for managing customer relationships help businesses find new consumers, build lasting relationships with them, and boost client retention to increase profitability. CRM systems evaluate consumer personal and behavioral data using machine learning models to give businesses a competitive edge by raising customer retention rates. These models can identify clients who are likely to leave and their motivations for doing so (Sabbeh, S. F. (2018). [11]). Businesses have concentrated on developing loyalty and client retention initiatives because happy clients are their most precious assets. The main objective of customer retention programmes is to guarantee that relationships with value-adding customers are maintained by reducing their rate of defection. Developing a devoted clientele is essential for a company to thrive in fiercely competitive markets (Nasır, S. (2017). [12]).

Student satisfaction with college or courses can be analyzed using data mining approaches (Dejaeger, K. et al. (2012). [13]). Student satisfaction is a short-term mindset that emerges from an evaluation of students' educational experiences, services, and various facilities (Weerasinghe, I. S. et al. (2017). [14]). Universities today face significant challenges to attract new students due to the demand for high-quality human resources for societal development and the growing competitiveness in the higher education sector. High quality with a high level of student satisfaction is one of the crucial keys to this situation of universities (Son, H. T.et al.(2018). [15]). Comparison of the perceived performance to the expectation might result in a feeling of satisfaction or disappointment, which is referred to as satisfaction (Havidz, H. et al. (2020). [16]). Student satisfaction refers to a mindset that emerges from evaluating a student's educational experiences in the short term (IM Salinda Weerasinghe. et al. (2017). [17]). Student satisfaction is a complex process that is affected in different ways by many circumstances. There are two categories of institutional and personal impacts on student satisfaction in higher education. Personal attributes include things like age, gender, and grade point average in addition to work and preferred learning style. Examples of institutional components include the caliber of instruction, the timeliness of teacher feedback, the clarity of expectations, and the teaching style (Appleton-Knapp, S. et al. (2006). [18]). Campus atmosphere and student life are important variables that affect students' satisfaction, as are individual consideration, effective instruction, recruitment and financial aid, registration efficacy, campus safety and security, quality service, and student-centeredness (Elliott, K. M. et al. (2001). [19]).

The standard of the university's common areas, auditoriums, and libraries is the element that has the biggest impact on students' happiness with those facilities (Hanssen, T. E. S. et al. (2015). [20]). The study's key conclusions show that factors linked to service quality are most frequently present, followed by factors relating to customer satisfaction, trust, loyalty, and commitment (Alshamsi, A. et al. (2021). [21]). The crucial aspects that education managers need to concentrate on are responsiveness, communication, and access (Douglas, J. et al. (2008). [22]). The research has pinpointed several

instances of the service experience when there was either a lack of student happiness or a fluctuating degree of student satisfaction (Aldridge, S. et al. (1998). [23]). The degree of service quality has a significant impact on students' satisfaction in a variety of ways (Malik, M. E. et al. (2010). [24]). Outlines the methodological development of Higher Education Performance Only, a novel instrument for assessing service quality that captures the real factors that affect it in the higher education industry (Abdullah, F. (2006). [25]). Positive customer satisfaction is influenced by service quality, tangibility, empathy, assurance, and responsiveness (Mosimanegape, P. et al. (2020). [26]). The quality of the classroom, the relationship between lecturers and students, student engagement, the course's topic, the tools accessible for learning, the libraries' resources, and the learning materials themselves all have a significant impact on how satisfied students are in universities (García-Aracil, A. (2009). [27], Kuh, G. (2001). [28], Sojkin, B. et al. (2012). [29]). Furthermore, it has been found that the following elements—teaching efficacy, flexible curriculum, university status and prestige, independence, faculty concern, student growth and development, student centeredness, campus climate, institutional effectiveness, and social conditions—have a major impact on students' satisfaction in higher education (Douglas, J.et al.(2006). [30], Palacio, A. et al. (2002).[31]). Students' satisfaction in international higher education is significantly influenced by the quality of the lecturers, the caliber and accessibility of the resources, and the effective use of technology (Wilkins, S. et al. (2013). [32]). The quality of the academic programme, the instruction, financial aid, tuition, and university facilities all have a big impact on how satisfied students are (Farahmandian, S. et al. (2013). [33]).

Table 1: Scholarly literature review of Machine learning Algorithms on customer satisfaction

S. No.	Area and Focus of the Research	Outcome of the Research	Reference
1.	Decision Tree for customer relationship management	The decision tree appeared to be an appropriate technique for identifying and categorizing the criteria that convert prospects into actual customers.	Kazemi, A. et al. (2011). [34]
2.	Clustering and Subgroup discovery	K-Medoids and CN2-SD algorithms are used to understand consumer likes and preferences, enabling businesses to be more effective and responsive to customer requests and gaining a competitive advantage.	Brito, P. Q. et al. (2015). [35]
3.	The student data is subjected to Decision Tree, Naive Bayes, and Rule Based categorization approaches in order to create the best students' academic performance prediction model.	A rule-based model gave the best result of 71.3% accuracy.	Ahmad, F. et al. (2015) .[36]
4.	Machine learning algorithm for churn prediction	SVM can be used with boosting algorithm for high accuracy	Saran Kumar, A. et al. (2016). [37]
5.	Predicting customer churn using deep learning.	Convolutional Neural Network is implemented to classify churner and non-churner customer and the result shows high accuracy.	Mishra, A. et al. (2017). [38]
6.	To analyze the student performance in universities using different data mining classifier algorithms	Bayesian Network classifier has the highest accuracy of 92%	Almarabeh, H. (2017). [39]
7.	Educational data mining	It is feasible to offer prompt Students that perform poorly are given guidance and help, while high performers are given opportunities and advice.	Asif, R.(2017).[40]

8.	Comparative study to analyze various machine learning algorithm for customer retention	Random forest and Ad Boost algorithm gave highest accuracy.	Sabbeh, S. F. (2018).[41]
9.	Analysis of customer churn using Random forest machine learning algorithm	The findings show that the RF algorithm and k-means clustering, two methods for consumer profiling, both performed better under the proposed churn prediction model.	Ullah, I. et al. (2019).[42]
10.	Customer retention strategies for business growth.	Study on how small firms may use customer retention including managing clients, their satisfaction, and trust to keep their current clients and improve their lifetime.	Hawkins, D. et al. (2019). [43]
11.	Customer churns using deep learning.	Created general illustration of feature engineering procedures that may be used to forecast churn in any non-subscription-based business.	Shah, M. et al. (2019). [44]
12.	Machine learning approach to predict customer retention in advance	The prediction, the length of the inactive period, and the time-series length are the three factors for which a linear SVM works acceptably. Random Forest has the best performance for forecasting lost clients, with a specificity of up to 92 percent.	Schaeffer, S. et al. (2020). [45]
13.	Bayesian classifier for churn prediction	RPS creation creates a supervised weighted classifier for the Bayes inference model that reduces bias and extracts valuable representational heuristic patterns.	Bhattacharya. et al. (2020).[46]
14.	Machine learning techniques for customer interest and retention	CRM employs supervised learning methods in 48.48% of cases, unsupervised learning methods in 15.15% of cases, and other methods in 9.09% of cases.	Singh, N. et al. (2020). [47]
15.	Efficiency of data mining and machine learning for customer retention	The performance of clustering is enhanced by the use of multi variant cluster similarity clustering. By choosing a purchase pattern and determining the user's interest based on frequency metrics, it is possible to find other users who have that interest, which enhances the effectiveness of customer retention.	Kumar, M. R. et al. (2021). [48]
16.	Customer retention using machine learning algorithm	Support vector machines can be used effectively for customer retention.	VLN, R. K., et al. (2021). [49]
17.	Customer relationship management for client satisfaction.	This study examines consumer behaviour and brand perception in the context of marketing, mostly in small and medium-sized businesses. Consequently, the purpose of this study is to assess the connections between customer loyalty, customer satisfaction, and customer trust.	Khan, R. U. et al. (2022). [50]

18.	To create a model that provides the banking industry with a useful churn prediction.	Also, the experimental findings showed that RF worked effectively for the entire feature-selected datasets. As a result, the suggested RF predictor can be utilised to estimate customer turnover on a regular basis from a variety of angles.	Muneer, A. et al. (2022). [51]
19.	Churn prediction using machine learning	The highest accuracy Adaboost and XGboost Classifiers are 81.71% and 80.8%.	Lalwani, P. et al. (2022). [52]

Table 2: Comparison of Machine learning algorithm for the classification of satisfaction

S. No.	Area and Focus of the Research	Outcome of the Research	Reference
1.	ML Techniques for students satisfaction	The best outcomes were produced by support vector machines, which had an overall prediction rate of 87.23%. Decision tree: 87.16% Artificial neural networks: 86.45% Logistic regression: 86.12%	Delen, D. (2010). [53]
2.	ML models for customer churn prediction	Decision Tree classifier: Accuracy 94% Support Vector Machines: Accuracy 93% Naïve Bayes and Logistic Regression: Accuracy 86%	Vafeiadis, T. et al. (2015). [54]
3.	Machine learning for performance of student	To forecast student success in an academic setting, a model is put forth. The algorithm used is a type of neural network.	Agrawal, H. et al. (2015). [55]
4.	Machine learning algorithms for classification	SVM: Accuracy of 72.92% Random Forest: Accuracy of 71.88% Naïve Bayes: Accuracy of 70.77%	Osisanwo, F. et al. (2017). [56]
5.	Support Vector Machine for predicting student retention.	Using the SVM technique, which has a 78% accuracy rate, is a valuable resource for predicting student achievement.	Cardona, T. A. (2019). [57]
6.	Machine learning algorithm for prediction and classification	SVR is used in prediction to get the lowest Mean Square Value and maximum R2 and EV Scores.	Sekeroglu, B. et al. (2019). [58]
7.	Predictive Analytics in Higher Education	Random forest generated the best accuracy value of 73.33%	Brohi, S. et al. (2019). [59]
8.	Student Performance analysis	ANN: Accuracy of 77.04% Decision tree: 76.93% Logistic Regression: 74.53 Naïve bayers: 66.52	Altabrawee, H. et al. (2019). [60]
9.	Client Loyalty Classification	SVM method :The accuracy value of the is 76.42% Naive Bayes method: The accuracy value of 72.54%	Sulistiani, H. et al. (2019). [61]
10	Student satisfaction online course platform	The Accuracy of decision tree is 92.21%, The Accuracy of Random forest: 96.10%, The Accuracy of k-nearest neighbor: 95.67%,	Lee. et al. (2021). [62]

		The Accuracy of Only support vector machine: 97.29% Proposed algorithm (simulated annealing + support vector machine) :99.58%, respectively.	
11	For the performance assessment of educational institutions, a new hybrid fuzzy approach based on service quality	Hybrid fuzzy approach increased the accuracy of performance evaluation	Nojavan, et al. (2021). [63]
12	Classification of student satisfaction	Random Forest: Accuracy rate of 76.47%, Neural Network and Support Vector Machine algorithms: Accuracy rate of 74.12% on each.	Supriyadi, D. et al. (2022). [64]
13	Machine learning algorithm for the classification of student performance	SVM : Highest accuracy	Pallathadka, H. et al. (2023). [65]
14	SVM for customer feedback	SVM: 79% accuracy	Gunawan, L. et al. (2023). [66]

5. CURRENT STATUS & NEW RELATED ISSUES :

Based on the review conducted, student satisfaction analysis is most important for every institution to retain students as well as various courses. In the present scenario, considering public opinion is also helpful. Different machine learning algorithms and approaches are studied. By using a hybrid model of these algorithms, the accuracy of classification can be improved.

- Decision-making by considering various data sources has to be explored using machine learning approaches.
- Various contextual factors related to student and public interest in an institution have to be studied.
- Advanced machine learning and deep learning approaches can be studied to get more accurate classification results.

6. IDEAL SOLUTION, DESIRED STATUS & IMPROVEMENTS REQUIRED: (based on current status)

(1) Based on the literature survey advanced machine learning approaches and hybrid algorithms can improve the classification accuracy.
(2) A better decision can be made by analyzing and comparing existing algorithms for the classification of students and public satisfaction with colleges and private universities.
(3) Cross-institutional or cross-cultural studies are required to find the effectiveness of machine learning models for student satisfaction classification across diverse contexts.

7. RESEARCH GAP :

(1) Applications of advanced machine learning techniques are not explored. Ensemble models of machine learning will improve accuracy.
(2) By analyzing how various contextual factors like institutional characteristics, programme-specific factors, or socio-economic backgrounds interact with machine learning models and how they can be used to enhance the accuracy and interpretability of the classification results.
(3) Cross-institutional or cross-cultural research to confirm the potency of machine learning models for categorizing public and educational satisfaction in various circumstances.
(4) Establishing methods to automatically extract or choose the most important aspects of student happiness from a variety of data sources, such as surveys, social media, academic records.

(5) Creating methods to clarify and evaluate the conclusions drawn from these models, offering information on the elements that influence student satisfaction, and helping institutions make defensible decisions based on the model outputs.

8. RESEARCH AGENDAS BASED ON RESEARCH GAP :

(1) Data collection based on questionnaires from a cross-section of society.
(2) Finding an appropriate model for satisfaction classification with high accuracy by comparing the existing models
(3) Based on the data set and algorithms, develop a recommendation system for the colleges or Universities by considering students and the public as clients to make better decisions on their performance and boost business.

9. ANALYSIS OF RESEARCH AGENDAS :

Customers of a college or private university are students. Universities offer a wide range of facilities and services to students, including academic support, student services, and infrastructural services, which include IT support. One of the things that influence academic performance is how satisfied students and the public population near the particular institution are with the quality of the university's services. Data collection from various fields of society has to be considered to train the machine to overcome all possible issues related to satisfaction levels. Effective classification models are required to be developed to predict satisfaction with universities or institutions. Early recommendations help to take necessary actions against any kind of pathetic situation.

10. RESEARCH PROPOSAL :

Following a study and evaluation of the available research literature review, the article suggests conducting mega-research on proposing student and general public satisfaction classifications with high accuracy models towards colleges and private universities.

10.1 Proposed title: Examining the accuracy of student and public satisfaction classification towards colleges and private universities with advanced machine learning approaches.

10.2 Purpose: Study of student and public satisfaction towards an institution using machine learning by considering various aspects and data sources to get high-accuracy classification models for better decision-making.

11. ANALYSIS OF MACHINE LEARNING APPROACHES FOR CUSTOMER SATISFACTION USING ABCD FRAMEWORK :

Machine Learning (ML) is a large, multidisciplinary field that draws on ideas from many different branches of mathematics and science, including computer science, statistics, cognitive science, engineering, and optimization theory (Soofi, A. A. et al. (2017). [67]). Machine learning approaches can be effectively used to identify customer satisfaction. By combining various features affecting the satisfaction of customers, machine learning approaches can predict the accuracy of customer satisfaction, which can be used for decision-making. ABCD stands for Advantages, Benefits, Constraints, and Disadvantages (Aithal, P. S. et al. (2015). [68]). ABCD frameworks can be effectively employed in a variety of study domains (Aithal, P. S. et al. (2016). [69], Aithal, P. S. et al. (2016). [70], Aithal, P. S. et al. (2018). [71], Aithal, P. S. (2016). [72]). It is possible to employ ABCD analysis as a research methodology (Aithal, P. S. (2017). [73]).

ADVANTAGES:

(1) Predictive Analytics: Machine learning algorithms can analyze historical data to predict student satisfaction levels and identify factors that influence satisfaction. By understanding these factors, colleges and universities can take proactive measures to address potential issues and enhance the overall student experience (Kurni, M.et al. (2023). [74]).

(2) Personalized Recommendations: Personalized suggestions for courses, extracurricular activities, and support services can be generated using machine learning algorithms that analyse student preferences, course history, and other pertinent data. This makes it easier for students to identify programmes that suit their interests, which boosts satisfaction and engagement.

(3) Sentiment Analysis: Sentiment analysis can be done on comments, surveys, and social media data using machine learning algorithms. Colleges and universities can better satisfy the requirements and

expectations of their stakeholders by tailoring their programmes and identifying areas for development by studying public opinion of the institution (Wankhade, M.et al. (2022). [75]).

(4) Resource Optimization: Machine learning algorithms can help colleges and universities optimize resource allocation. By analyzing historical data, institutions can identify trends and patterns in resource utilization, such as classroom usage, faculty workload, and facility maintenance. This enables efficient allocation of resources, leading to cost savings and improved service delivery.

(5) Early Warning Systems: Machine learning algorithms can analyze various data sources, including academic performance and engagement metrics, to identify students who may be at risk of dissatisfaction or attrition. By detecting early warning signs, colleges and universities can intervene with targeted support and interventions to improve student satisfaction and retention rates.

BENEFITS:

(1) Personalized Learning: A machine learning algorithm can be used to analyze student data to create a personalized path. This will lead to better satisfaction.

(2) Student Retention: Institutions can spot patterns and indicators of students at risk of dropping out or having academic issues by utilizing machine learning algorithms

(3) Admissions and Enrollment Management: The analysis of previous admissions data by machine learning algorithms can help colleges, higher education institutions improve their admissions standards and make better enrollment decisions.

(4) Recommender Systems: Machine learning algorithms can be employed to develop recommender systems that suggest relevant courses, programs, or extracurricular activities to students based on their interests and previous choices. These systems can enhance student engagement, promote exploration of diverse educational opportunities, and ultimately increase student satisfaction.

(5) Feedback Analysis: There is no question that student feedback is crucial for improving the educational sector. Therefore, Quality Assurance Units make an effort to gather those feedbacks as useful inputs using a variety of methods. Machine learning algorithms can process and analyze student feedback, such as course evaluations or surveys, to extract valuable insights. Institutions can use this feedback analysis to identify areas of improvement, assess the effectiveness of teaching methods, and implement changes to enhance student satisfaction (Lwin, H. H., et al. (2020). [76]).

CONSTRAINTS:

(1) Availability and quality of data: Machine learning algorithms rely heavily on data availability and quality. For effective application, colleges and universities need to have access to comprehensive and reliable data related to student satisfaction. This data may include surveys, feedback, academic performance, extracurricular activities, and other relevant information

(2) Privacy and ethical considerations: Working with student data requires strict adherence to privacy laws and ethical guidelines. Institutions must take appropriate measures to protect student information and ensure compliance with relevant regulations,

(3) Limited sample size and diversity: The size and diversity of the student population can impact the effectiveness of machine learning algorithms. It is important to collect data from a wide range of students to ensure the algorithms are inclusive and representative.

(4) Human intervention and support: While machine learning algorithms should not replace human interaction and support, Personalised guidance plays a crucial role in student satisfaction. Institutions should use machine learning algorithms as a tool to support human decision-making and not completely rely on automated systems.

(5) Changing student needs and preferences: Student needs and preferences can evolve over time, and machine learning models may need regular updates to stay relevant.

DISADVANTAGES:

(1) Data Bias: For making predictions machine learning algorithms significantly rely on past data. The algorithm may reinforce biases present in the training data or reflect historical inequities, producing unfair or discriminating results.

(2) Lack of Interpretability: Many machine learning algorithms, including deep neural networks, function as "black boxes," making it challenging to figure out and understand why a particular choice was made.

(3) Implementation Challenges: It can be difficult to implement machine learning algorithms in a learning environment. Infrastructure, technical know-how, and continual maintenance are needed.
(4) Ethical Considerations: The use of machine learning algorithms in student satisfaction initiatives raises ethical considerations. Institutions must ensure transparency, fairness, and accountability in the implementation and use of these algorithms.

12. SUGGESTIONS TO IMPLEMENT RESEARCH ACTIVITIES :

(1) Data collection and preprocessing.
(2) Ensure data privacy.
(3) Identifying relevant features for student satisfaction.
(4) Data analysis and visualization.
(5) Appropriate model selection based on data collected.
(6) Model training and evaluation.
(7) Analyze the models' predictions to study the significant features that contribute to the satisfaction of students.
(8) Limitations and future work.

13. CONCLUSION :

The integration of machine learning into understanding and improving customer satisfaction is a powerful and promising avenue for businesses, including those in various sectors, seeking to thrive in the competitive landscape. Future research in this domain should focus on refining existing models, exploring novel approaches, and devising strategies to bridge the gap between customer expectations and business outcomes.

REFERENCES :

[1] Xiao, G., Kuan, T. W., Li, F., Ling, M., & Tseng, S. P. (2022, November). Systematic Review of Machine Learning Methods in Customer Satisfaction Prediction. In *2022 10th International Conference on Orange Technology (ICOT)* (1-3). Google Scholar↗

[2] Johny, C. P., & Mathai, P. P. (2017). Customer churn prediction: A survey. *International Journal of Advanced Research in Computer Science*, *8*(5), 2178-2181. Google Scholar↗

[3] Pizam, A. Shapoval, V., & Ellis, T. (2016). Customer satisfaction and its measurement in hospitality enterprises: a revisit and update. *International journal of contemporary hospitality management*. *28*(1), 2-35. Google Scholar↗

[4] Paul, J., Mittal, A., & Srivastav, G. (2016). Impact of service quality on customer satisfaction in private and public sector banks. *International Journal of Bank Marketing*, *34*(5), 606-622. Google Scholar↗

[5] Kant, R and Jaiswal, D. (2017). The impact of perceived service quality dimensions on customer satisfaction: An empirical study on public sector banks in India, *International Journal of Bank Marketing*, *35*(3) 411-430. Google Scholar↗

[6] Hui, E. C. M., and Zheng, X. (2010) Measuring customer satisfaction of FM service in housing sector: A structural equation model approach, *Facilities*, 28(5/6) 306-320. Google Scholar↗

[7] El-Adly, M. I. (2019). Modelling the relationship between hotel perceived value, customer satisfaction, and customer loyalty. *Journal of Retailing and Consumer Services*, *50(1)*, 322-332. Google Scholar↗

[8]Hristova, G. (2022, September). Text analytics for customer satisfaction prediction: A case study in the banking domain. In *AIP Conference Proceedings*, *2505*(1), 100001. Google Scholar↗

[9] Chakraborty, S., Mengersen, K., Fidge, C., Ma, L., & Lassen, D. (2016). A Bayesian Network-based customer satisfaction model: a tool for management decisions in railway transport. *Decision Analytics*, *3*(1), 1-24. Google Scholar↗

[10] S. Kumar and M. Zymbler. (2019).A machine learning approach to analyze customer satisfaction from airline tweets. *Journal of Big Data*, *6*(1), 1–16. Google Scholar↗

[11] Sabbeh, S. F. (2018). Machine-learning techniques for customer retention: A comparative study. *International Journal of advanced computer Science and applications*, *9*(2). 273-281. Google Scholar↗

[12] Nasır, S. (2017). Customer retention strategies and customer loyalty. In *Advertising and Branding: Concepts, Methodologies, Tools, and Applications*, *1*(1). 1178-1201. Google Scholar↗

[13] Dejaeger, K., Goethals, F., Giangreco, A., Mola, L., & Baesens, B. (2012). Gaining insight into student satisfaction using comprehensible data mining techniques. *European Journal of Operational Research*, *218*(2), 548-562. Google Scholar↗

[14]Weerasinghe, I. S., & Fernando, R. L. (2017). Students' satisfaction in higher education. *American journal of educational research*, *5*(5), 533-539. Google Scholar↗

[15] Son, H. T., Ha, N. T., & Khuyen, P. T. M. (2018). Measuring Students' Satisfaction with higher education service-An Experimental Study at Thainguyen University. *International Journal of Business Marketing and Management (IJBMM)*, *3*(4), 21-34. Google Scholar↗

[16] Havidz, H. B. H., & Mahaputra, M. R. (2020). Brand image and purchasing decision: Analysis of price perception and promotion (literature review of marketing management). *Dinasti International Journal of Economics, Finance & Accounting*, *1*(4), 727-741. Google Scholar↗

[17] Salinda Weerasinghe, I. M. and R. Lalitha, S. Fernando, (2017). 'Students' Satisfaction in Higher Education Literature Review. *American Journal of Educational Research*, *5*(5), 1-10. Google Scholar↗

[18] Appleton-Knapp, S. & Krentler, K (2006). Measuring student expectations and their effects on satisfaction: the importance of managing student expectations. *Journal of Marketing Education, 28*(3) 254-264. Google Scholar↗

[19] Elliott, K. M., & Healy, M. A. (2001). Key factors influencing student satisfaction related to recruitment and retention. *Journal of marketing for higher education, 10(*4), 1-11. Google Scholar↗

[20] Hanssen, T. E. S., & Solvoll, G. (2015). The importance of university facilities for student satisfaction at a Norwegian University. *Facilities*. *1*(0), 1-20. Google Scholar↗

[21] Alshamsi, A., Alshurideh, M., Kurdi, B. A., & Salloum, S. A. (2021). The influence of service quality on customer retention: A systematic review in the higher education. In *Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2020*, *1*(1),404-416. Google Scholar↗

[22] Douglas, J., McClelland, R., & Davies, J. (2008). The development of a conceptual model of student satisfaction with their experience in higher education. *Quality assurance in education*, *16*(1), 19-35. Google Scholar↗

[23] Aldridge, S., & Rowley, J. (1998). Measuring customer satisfaction in higher education. *Quality assurance in education*, *6*(4), 197-204. Google Scholar↗

[24] Malik, M. E., Danish, R. Q., & Usman, A. (2010). The impact of service quality on students' satisfaction in higher education institutes of Punjab. *Journal of management research*, *2*(2), 1-11. Google Scholar↗

[25] Abdullah, F. (2006). The development of HEdPERF: a new measuring instrument of service quality for the higher education sector. *International journal of consumer studies*, *30*(6), 569-581. Google Scholar↗

[26] Mosimanegape, P., Jaiyeoba, O. O., Iwu, C. G., & Chekula-Mahama, C. (2020). Examining the relationship between service quality and customer satisfaction in the public service. The case of Botswana. *WSEAS Transactions on Business and Economics*, *1*(1), 1-25. Google Scholar↗

[27] García-Aracil, A. (2009). European graduates' level of satisfaction with higher education. *Higher Education, 57*(1), 1-21. Google Scholar↗

[28] Kuh, G. & Hu, S., 2001. The effects of student-faculty interaction in the 1990s. *Review of Higher Education,24*(3), 309-332. Google Scholar↗

[29] Sojkin, B., Bartkowiak, P. & Skuza, A. (2012). Determinants of higher education choices and student satisfaction: the case of Poland. *Higher Education*, *63*(5), 565-81. Google Scholar↗

[30] Douglas, J., Douglas, A. & Barnes, B., (2006). Measuring student satisfaction at a UK university. *Quality Assurance in Education*, *1*(1),251-267. Google Scholar↗

[31] Palacio, A., Meneses, G. & Perez, P., (2002). The configuration of the university image and its relationship with the satisfaction of students. *Journal of Educational Administration*, *40*(5), 486-505. Google Scholar↗

[32] Wilkins, S. & Balakrishnan, M. S., (2013). Assessing student satisfaction in transnational higher education. *International Journal of Educational Management,1*(1), 146-153. Google Scholar↗

[33] Farahmandian, S., Minavand, H. & Afshard, M., (2013). Perceived service quality and student satisfaction in higher education. *Journal of Business and Management*, *12*(4),65-74. Google Scholar↗

[34] Kazemi, A., & Babaei, M. E. (2011). Modelling Customer Attraction Prediction in Customer Relation Management using Decision Tree: A Data Mining Approach. *Journal of Optimization in Industrial Engineering*, *4*(9), 37-45. Google Scholar↗

[35] Brito, P. Q., Soares, C., Almeida, S., Monte, A., & Byvoet, M. (2015). Customer segmentation in a large database of an online customized fashion business. *Robotics and Computer-Integrated Manufacturing*, *36*(1), 93-100. Google Scholar↗

[36] Ahmad, F., Ismail, N. H., & Aziz, A. A. (2015). The prediction of students' academic performance using classification data mining techniques. *Applied mathematical sciences*, *9*(129), 6415-6426. Google Scholar↗

[37] Saran Kumar, A., & Chandrakala, D. (2016). A survey on customer churn prediction using machine learning techniques. *International Journal of Computer Applications*, *97*(5), 88-87. Google Scholar↗

[38] Mishra, A., & Reddy, U. S. (2017, December). A novel approach for churn prediction using deep learning. In *2017 IEEE International conference on computational intelligence and computing research (ICCIC)*, *1*(1), 1-4. Google Scholar↗

[39] Almarabeh, H. (2017). Analysis of students' performance by using different data mining classifiers. *International Journal of Modern Education and Computer Science*, *9*(8), 1-9. Google Scholar↗

[40] Asif, R., Merceron, A., Ali, S. A., & Haider, N. G. (2017). Analyzing undergraduate students' performance using educational data mining. *Computers & Education*, *11*(3), 177-194. Google Scholar↗

[41] Sabbeh, S. F. (2018). Machine-learning techniques for customer retention: A comparative study. *International Journal of advanced computer Science and applications*, *9*(2). 273-281. Google Scholar↗

[42] Ullah, I., Raza, B., Malik, A. K., Imran, M., Islam, S. U., & Kim, S. W. (2019). A churn prediction model using random forest: analysis of machine learning techniques for churn prediction and factor identification in telecom sector. *IEEE access*, *7*(1), 60134-60149. Google Scholar↗

[43] Hawkins, D., & Hoon, S. (2019). The impact of customer retention strategies and the survival of small service-based businesses. *Stephanie, The Impact of Customer Retention Strategies and the Survival of Small Service-Based Businesses*, *1(*1), 1-25. Google Scholar↗

[44] Shah, M., Adiga, D., Bhat, S., & Vyeth, V. (2019). Prediction and causality analysis of churn using deep learning. *Comput. Sci. Inf. Technol*, *9*(13), 153-165. Google Scholar↗

[45] Schaeffer, S. E., & Sanchez, S. V. R. (2020). Forecasting client retention—A machine-learning approach. *Journal of Retailing and Consumer Services*, *52*(1), 2-24. Google Scholar↗

[46] Bhattacharya, P., Ladha, A., Kumar, A., Verma, A., & Bodkhe, U. (2020, November). BaYcP: A novel Bayesian customer Churn prediction scheme for Telecom sector. *In 2020 Sixth International Conference on Parallel, Distributed and Grid Computing (PDGC)*, *1*(1), 260-265. Google Scholar↗

[47] Singh, N., Singh, P., & Gupta, M. (2020). An inclusive survey on machine learning for CRM: a paradigm shift. *Decision*, *47*(4), 447-457. Google Scholar↗

[48] Kumar, M. R., Venkatesh, J., & Rahman, A. M. Z. (2021). Data mining and machine learning in retail business: developing efficiencies for better customer retention. *Journal of Ambient Intelligence and Humanized Computing*, *1*(1),1-13. Google Scholar↗

[49] VLN, R. K., & Deeplakshmi, P. (2021, January). Dynamic Churn Prediction using Machine Learning Algorithms-Predict your customer through customer behaviour. In *2021 International Conference on Computer Communication and Informatics (ICCCI)*, *1*(1), 1-6. Google Scholar↗

[50] Khan, R. U., Salamzadeh, Y., Iqbal, Q., & Yang, S. (2022). The impact of customer relationship management and company reputation on customer loyalty: The mediating role of customer satisfaction. *Journal of Relationship Marketing*, *21*(1), 1-26. Google Scholar↗

[51] Muneer, A., Ali, R. F., Alghamdi, A., Taib, S. M., Almaghthawi, A., & Ghaleb, E. A. A. (2022). Predicting customers churning in banking industry: A machine learning approach. *Indonesian Journal of Electrical Engineering and Computer Science*, *26*(1), 539-549. Google Scholar↗

[52] Lalwani, P., Mishra, M. K., Chadha, J. S., & Sethi, P. (2022). Customer churn prediction system: a machine learning approach. *Computing*, *1(*1), 1-24. Google Scholar↗

[53] Delen, D. (2010). A comparative analysis of machine learning techniques for student retention management. *Decision Support Systems*, *49*(4), 498-506. Google Scholar↗

[54] Vafeiadis, T., Diamantaras, K. I., Sarigiannidis, G., & Chatzisavvas, K. C. (2015). A comparison of machine learning techniques for customer churn prediction. *Simulation Modelling Practice and Theory*, *55*, 1-9. Google Scholar↗

[55] Agrawal, H., & Mavani, H. (2015). Student performance prediction using machine learning. *International Journal of Engineering Research and Technology*, *4*(03), 111-113. Google scholar↗

[56] Osisanwo, F. Y., Akinsola, J. E. T., Awodele, O., Hinmikaiye, J. O., Olakanmi, O., & Akinjobi, J. (2017). Supervised machine learning algorithms: classification and comparison. *International Journal of Computer Trends and Technology (IJCTT)*, *48*(3), 128-138. Google Scholar↗

[57] Cardona, T. A. (2019). Predicting student retention using support vector machines. *Procedia Manufacturing*, *39*, 1827-1833. Google Scholar↗

[58] Sekeroglu, B., Dimililer, K., & Tuncal, K. (2019, March). Student performance prediction and classification using machine learning algorithms. In *Proceedings of the 2019 8th International Conference on Educational and Information Technology 1*(1), 7-11. Google scholar↗

[59]Brohi, S. N., Pillai, T. R., Kaur, S., Kaur, H., Sukumaran, S., & Asirvatham, D. (2019). Accuracy comparison of machine learning algorithms for predictive analytics in higher education. In *Emerging Technologies in Computing: Second International Conference, iCETiC 2019, London, UK, August 19–20, 2019, Proceedings 2*, *1*(1), 254-261. Google Scholar↗

[60] Altabrawee, H., Ali, O. A. J., & Ajmi, S. Q. (2019). Predicting students' performance using machine learning techniques. *Journal of University of Babylon for pure and applied sciences*, *27*(1), 194-205. Google Scholar↗

[61] Sulistiani, H., Muludi, K., & Syarif, A. (2019, October). Implementation of Dynamic Mutual Information and Support Vector Machine for Customer Loyalty Classification. In *Journal of Physics: Conference Series*, *1338*(1), 0-12050. Google Scholar↗.

[62] Lee, C. Y., Ruan, L. M., Lee, Z. J., Huang, J. Q., Yao, J., Ning, Z. Y., & Tu, J. F. (2021). Study on the university students' satisfaction of the wisdom tree massive open online course platform based on parameter optimization intelligent algorithm. *Science Progress*, *104*(3), 1-24. Google Scholar↗

[63] Nojavan, M., Heidari, A., & Mohammaditabar, D. (2021). A fuzzy service quality based approach for performance evaluation of educational units. *Socio-Economic Planning Sciences*, *73*(1), 100-816. Google Scholar↗

[64] Supriyadi, D., Purwanto, P., & Warsito, B. (2022, November). Comparison of random forest algorithm, support vector machine and neural network for classification of student satisfaction towards higher education services. In *AIP Conference Proceedings*, *2578*(1), 1-15. Google Scholar↗

[65]Pallathadka, H., Wenda, A., Ramirez-Asís, E., Asís-López, M., Flores-Albornoz, J., & Phasinam, K. (2023). Classification and prediction of student performance data using various machine learning algorithms. *Materials today: proceedings*, *80*(1), 3782-3785. Google Scholar↗

[66] Gunawan, L., Anggreainy, M. S., Wihan, L., Lesmana, G. Y., & Yusuf, S. (2023). Support vector machine based emotional analysis of restaurant reviews. *Procedia Computer Science*, *216*, 479-484. Google Scholar↗

[67] Soofi, A. A., & Awan, A. (2017). Classification techniques in machine learning: applications and issues. *Journal of Basic & Applied Sciences*, *13*(1), 459-465. Google Scholar↗

[68] Aithal, P. S., Shailashree, V., & Kumar, P. M. (2015). A new ABCD technique to analyze business models & concepts. *International Journal of Management, IT and Engineering*, *5*(4), 409-423. Google Scholar↗

[69] Aithal, P. S., Kumar, P. M., & Shailashree, V. (2016). Factors & elemental analysis of six thinking hats technique using ABCD framework. *International Journal of Advanced Trends in Engineering and Technology (IJATET)*, *1*(1), 85-95. Google Scholar↗

[70] Aithal, P. S., Shailashree. V. T., & Kumar, P. M. (2016). Analysis of ABC Model of Annual Research Productivity using ABCD Framework. *International Journal of Current Research and Modern Education (IJCRME)*, *1*(1), 846-858. Google Scholar↗

[71] Aithal, P. S., & Aithal, S. (2018). Factor & Elemental Analysis of Nanotechnology as Green Technology using ABCD Framework. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *3*(2), 57-72. Google Scholar↗

[72] Aithal, P. S. (2016). Study on ABCD analysis technique for business models, business strategies, operating concepts & business systems. *International Journal in Management and Social Science*, *4*(1), 95-115. Google Scholar↗

[73] Aithal, P. S. (2017). ABCD Analysis as Research Methodology in Company Case Studies. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *2*(2), 40-54. Google Scholar↗

[74] Kurni, M., Mohammed, M. S., & Srinivasa, K. G. (2023). Predictive Analytics in Education. In *A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning* (pp. 55-81). Cham: Springer International Publishing. Google Scholar↗

[75] Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, *55*(7), 5731-5780. Google Scholar↗.

[76] Lwin, H. H., Oo, S., Ye, K. Z., Lin, K. K., Aung, W. P., & Ko, P. P. (2020, June). Feedback analysis in outcome base education using machine learning. In *2020 17th International conference on electrical engineering/electronics, computer, telecommunications and information technology (ECTI-CON)*, 1(1), 767-770. Google Scholar↗

****