International Journal of Frontiers Research
DOI: 10.5281/zenodo
Journal Homepage: https://journalss.com/index.php/ijfr/

Volume 1 (1) April, 2025

Mahatma Gandhi University
Meghalaya India

| RESEARCH ARTICLE

DEVELOPMENT OF MACHINE LEARNING BASED SOFTWARE FOR PREDICTIONS AND CLASSIFICATION OF STUDENTS' ACADEMIC PERFORMANCE IN FEDERAL UNIVERSITIES, SOUTH-SOUTH, NIGERIA

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| ABSTRACT

The study developed a software driven by machine learning algorithm for the Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria. The purpose of this study was to development of Machine Learning based software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria. The study also investigated the perceive usefulness, ease of use and social influence of the Machine Learning based software. The study was guided by five specific purposes of the study. Three research questions were raised. This study was carried out in Federal Universities, South-South Nigeria. Two designs were adopted in the study, Rapid Application Development model design and Descriptive Survey research design. The population of the study consisted of 9934 lecturers in Federal Universities, South-South Nigeria, during the 2023/2024 academic session. A sample size of 397 lecturers which consisted of 198 Examination Officers and 199 Staff Advisers were selected for the study. The sample of the study was drawn using simple random sampling technique. A researcher made instrument titled "Usability of Machine Learning based Software Questionnaire" **(**UMLBSQ**)** was used in collecting data. The instrument was face validated by three experts. The reliability coefficient of 0.82 was obtained using Cronbach alpha Statistics. Mean and standard deviation were used to answer research questions while independent t-test was used to test the hypotheses at 0.05 level of significance. The result revealed that the respondents perceived the system as useful and easy to use. It was therefore recommended among others that Students should be allowed to engage with the predictions and classifications to set achievable goals and improve study strategies for better academic outcomes.

| KEYWORDS

Machine learning, software system, academic performance, prediction, classification

| INTRODUCTION

In recent years, the proliferation of computers and the internet has led to an exponential increase in the availability of publicly accessible data across various domains, generating vast datasets daily (Hamoud et al., 2021). By 2025, it is expected that the worldwide datasphere will grow to 175 trillion gigabytes (Vives et al., 2024). This digital data is well-suited for computer processing, enabling rapid analysis that exceeds human capabilities and making the exploitation of this data to gain a competitive advantage an essential task for modern institutions (Siagian et al., 2022; Hamoud et al., 2021). This extraction of

knowledge is typically achieved through algorithms—sets of instructions that allow a computer to learn from data, identify patterns, and make predictions without being explicitly programmed for every outcome (Hamoud et al., 2021; Qhatrunnada et al., 2023). These algorithms are the essential engines of machine learning, transforming raw data into actionable knowledge.

The field of machine learning (ML), a subfield of artificial intelligence coined by Arthur Samuel, is aimed at developing algorithms capable of autonomously learning from data and improving over time (Vives et al., 2024). Unlike traditional programming, ML algorithms are designed to identify patterns, make predictions, and adapt to new information by iteratively refining their internal parameters to minimize error (Vives et al., 2024). Advances in ML have enabled its incorporation into modern software systems, allowing them to learn, act, reason, and predict. Consequently, ML-based systems, such as recommendation engines and speech recognition, have become an integral part of daily life. These systems apply algorithms to data to make intelligent decisions automatically based on discovered patterns (Hamoud et al., 2021). One critical application of this technology is the prediction of student academic performance for the purpose of early intervention.

Academic performance, which refers to how well a student meets educational goals, is a primary concern for educational stakeholders as it affects students academically, economically, and psychologically (Qhatrunnada et al., 2023). In many regions, including Nigeria, there is a grave concern over mass failure in examinations and declining academic standards, often attributed to factors such as inadequate preparation, a shortage of qualified teachers, and poor learning environments (Uwadiae, 2020; Bulus, 2021; Gandonu et al., 2020). Poor performance can lead to academic attrition, a primary reason for student dropout, which has repercussions for individuals, institutions, and society at large (Ge, 2020; Adeniyi et al., 2022; Ibarra-Vazquez et al., 2023). An early discovery of students at risk of failure is therefore crucial for administering proper supervision and advice (Sana and Arain, 2019).

To this end, researchers have developed several machine learning models to predict academic performance. Studies have utilized algorithms such as Random Forest, Neural Networks, and Support Vector Machines for this purpose (Yagci, 2022). A machine learning-based software product for educational prediction utilizes these models to discover hidden patterns within student data to support effective decision-making and improve performance (Adeniyi et al., 2022). Specifically, classification techniques are used to predict a categorical label—such as "at-risk" or "on-track"—by training a classifier on historical data to identify complex relationships between student characteristics and their academic outcomes (Adil et al., 2023). Employing such models allows universities to analyze success and failure rates, informing strategies for enrollment management and resource optimization (Ersozlu et al., 2024).

However, the successful integration of such technology depends on more than just its predictive accuracy. Factors influencing the utilization of software, such as its perceived usefulness and ease of use, are crucial for ensuring effective implementation and user acceptance according to the Technology Acceptance Model (Sánchez-Prieto et al., 2020; Sonia and Marsasi, 2023). While previous research has explored various predictive models, a noticeable gap exists in the literature regarding the application of this technology in the context of Nigerian Federal Universities, particularly in the South-South region (Priya, 2022). The complex interrelation of factors influencing student performance in this specific context requires a dedicated solution.

Therefore, this study aims to address this gap. The main purpose is to develop a Machine Learning-based software for the prediction and classification of students' academic performance in Federal Universities in South-South Nigeria. Specifically, the study developed the software and determine its perceived usefulness and ease of use, thereby providing a data-driven tool for early intervention and improved educational outcomes.

| Research Questions

The following research questions will also guide the study:

1. What is the perceived usefulness of the Machine Learning software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria?
2. What is the ease of use of the Machine Learning software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria?

| Research Methodology

The study adopted Rapid Application Development (RAD) design model and Descriptive Survey research design. The rapid application development design model fits this research as it presents a working software early once the requirements are known; and this helps in providing a working machine learning based software early enough for the conduct of this study. On the other hand, the Descriptive Survey research design was adopted to systematically collect and analyze data on the software's usefulness, ease of use, social influence and satisfaction among users.

To carry out the development of any software, it is required to follow a software development methodology. A software development methodology helps in planning and monitoring the process of building information systems (Segue Technologies, 2015). Rapid Application Development (RAD) methodology was the system development methodology adopted in this study. The rapid application development methodology follows processes as depicted in Fig 3.1.

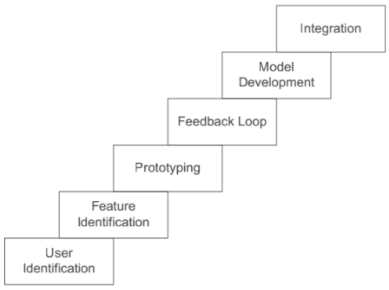


Figure 1: Rapid Application Development model
Source: (Researcher, 2024)

The first step is User Identification, where stakeholders such as Exam Officers and Staff Advisers are identified. Exam Officers and Staff Advisers input student data and view predictions. The next step is Feature Identification, where the important features needed for prediction are gathered from the dataset. These features include demographic details like age, gender, and marital status, academic performance metrics such as JAMB scores, and sponsor support levels. Identifying these features is crucial for developing an effective machine learning model.

Prototyping is the third step, where prototypes for data entry forms, prediction result displays, and report generation were created. After the prototype was built, a Feedback Loop was established, where users provided feedback on the design and usability of the system. This feedback was crucial for refining the user interface and ensuring it meets the needs of the lecturers. Adjustments based on this feedback were incorporated to improve the system's overall design and functionality.

Model Development was the fifth step, where machine learning model (Random Forest) was implemented using Python programming language. The model was trained to predict academic performance. Following model development, Integration was done by

connecting the frontend (data entry forms, result displays) with the backend (Python scripts for machine learning predictions and database). This ensured that user inputs were processed and predictions are returned seamlessly.

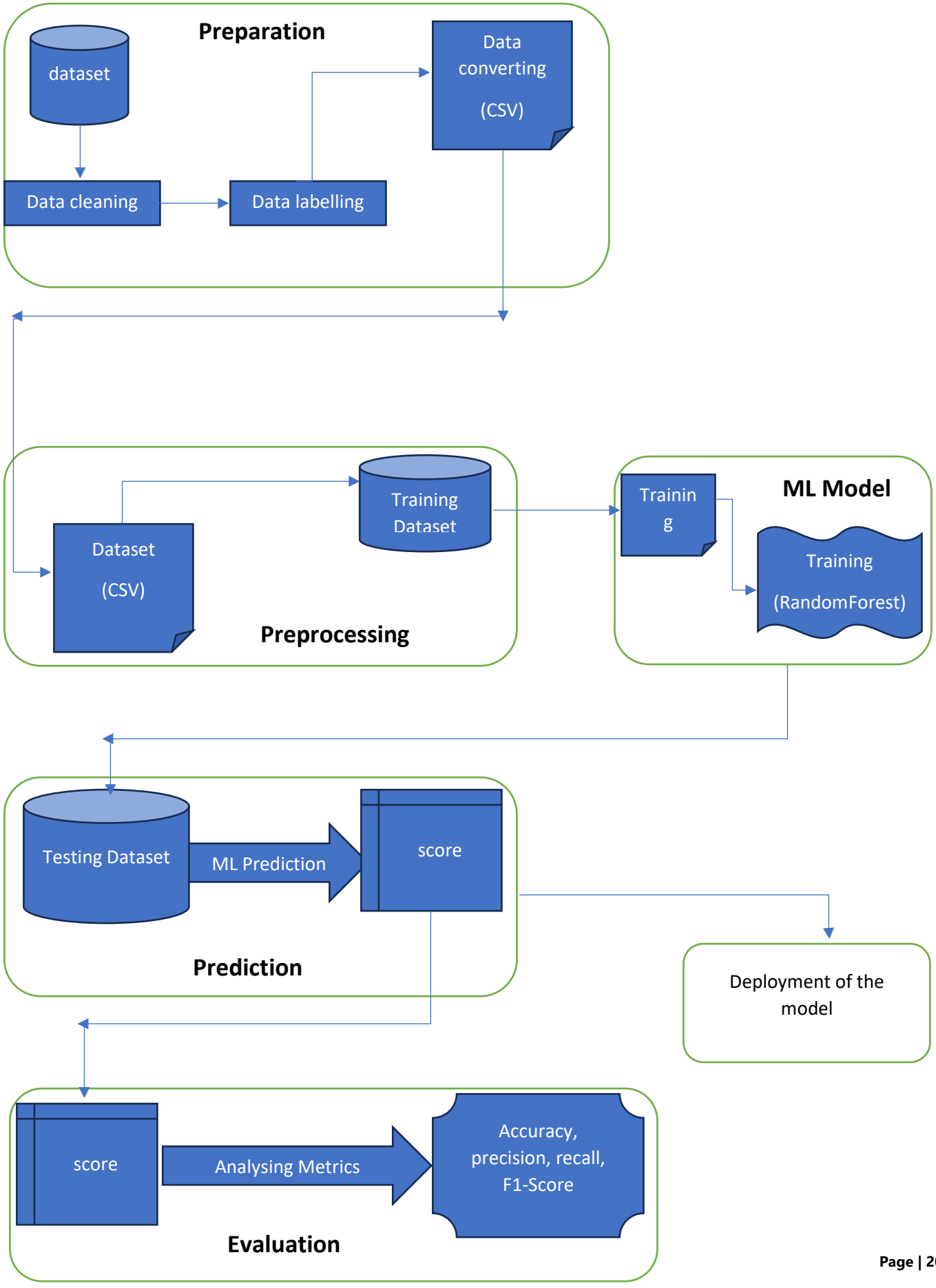

Preparation
dataset
Data converting
(CSV)
Data cleaning
Data labelling
Training Dataset
Dataset
(CSV)
Preprocessing
Trainin
g
ML Model
Training
(RandomForest)
Testing Dataset
ML Prediction
score
Prediction
Deployment of the model
score
Analysing Metrics
Accuracy, precision, recall, F1-Score
Evaluation

Figure 2: Overview of the model development
Source: (Researcher, 2024)

Preparation: The implementation began by fetching anonymous student datasets from Records Officers. The data were unorganized and messy, the data were also quite difficult to get started working with, due to not know exactly what they represented. There was some excess information such as course code, and period. These were disposed of. The data was then converted into binary information. (1s and 0s) instead of text information. This was the process of Data Labeling in Excel. Furthermore, they were converted into a Comma Separated Value (CSV) file through Excel, to be uploaded later into the Google Colab IDE with python (TensorFlow framework).

Preprocessing: With the CSV file ready, it was then uploaded to TensorFlow through Google Colab platform, and it was run on a high-performance GPU on Google Cloud which provided a free tier version of Google Colab and provided about 12 GB of RAM and with limited access to high memory Virtual Machines which have 25 GB RAM. The dataset was split into two separate datasets, one for training the ML algorithms (Training Dataset) and one for testing the ML algorithms (Testing datasets). That concluded the Preprocessing phase.

Machine Learning: The RandomForest model was built using Keras framework. The process was made easier due to Keras having prebuilt models and layers that were utilized to add the layers to the models, compile the models, fit the model which means to run the model and created a datatype called "history". The training dataset was inputted into the RandomForest model. Furthermore, in this phase, different metrics were added such as Accuracy, Precision, Recall, and F1 Score.

Prediction: The trained RandomForest model was then forced to make a prediction on the testing dataset and generated a value between 0% and 100%, that indicated how likely the outcome would be a success "1". The model was then deployed to an application (prediction system).

Evaluation: The overall value of metrics (Recall, Precision, F1 Score, and Accuracy) of RandomForest model was then fetched using the Sklearn which provides complete functions to measure the mentioned metrics.

System Modeling

System modeling is the process of developing abstract models of a system, with each model presenting a different view or perspective of the system.

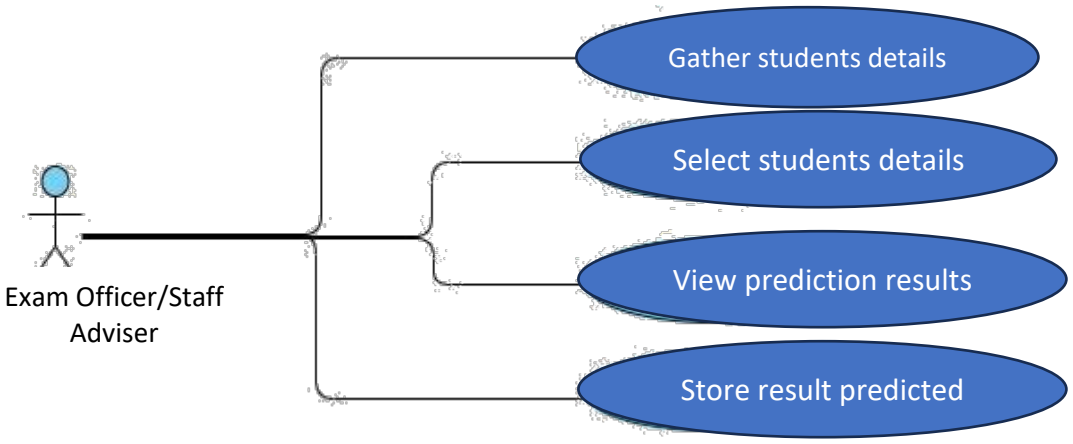


Figure 3: Use case diagram
Source: (Researcher, 2024)

The use case diagram presented in Figure 3 shows the main actor or user of the system as the Examination Officers and Staff Advisers. The activities performed by the actors as shown in the diagram include gathering of students' details, selecting student details in the software, viewing the predicted results and storing the predicted results for future use.

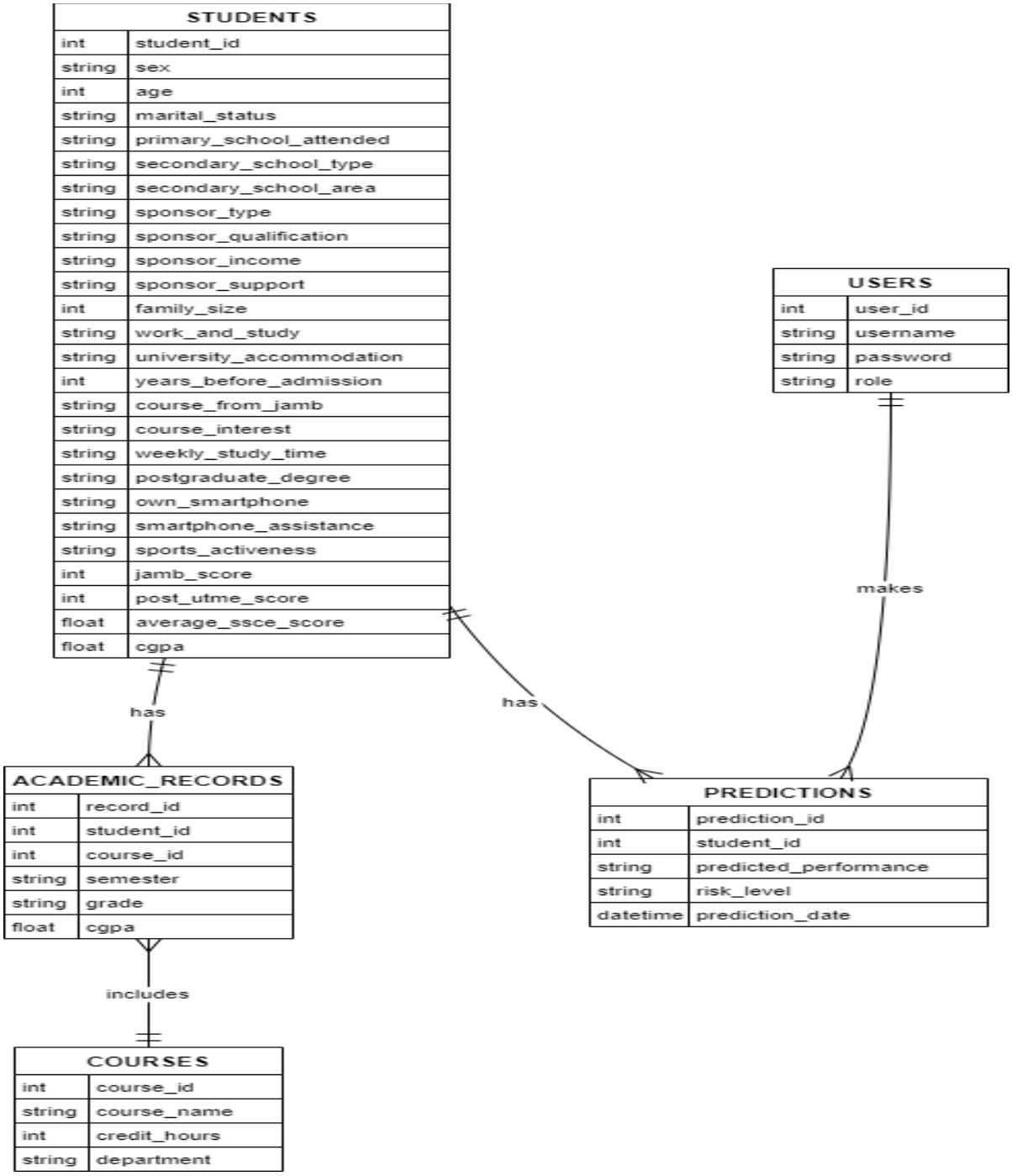
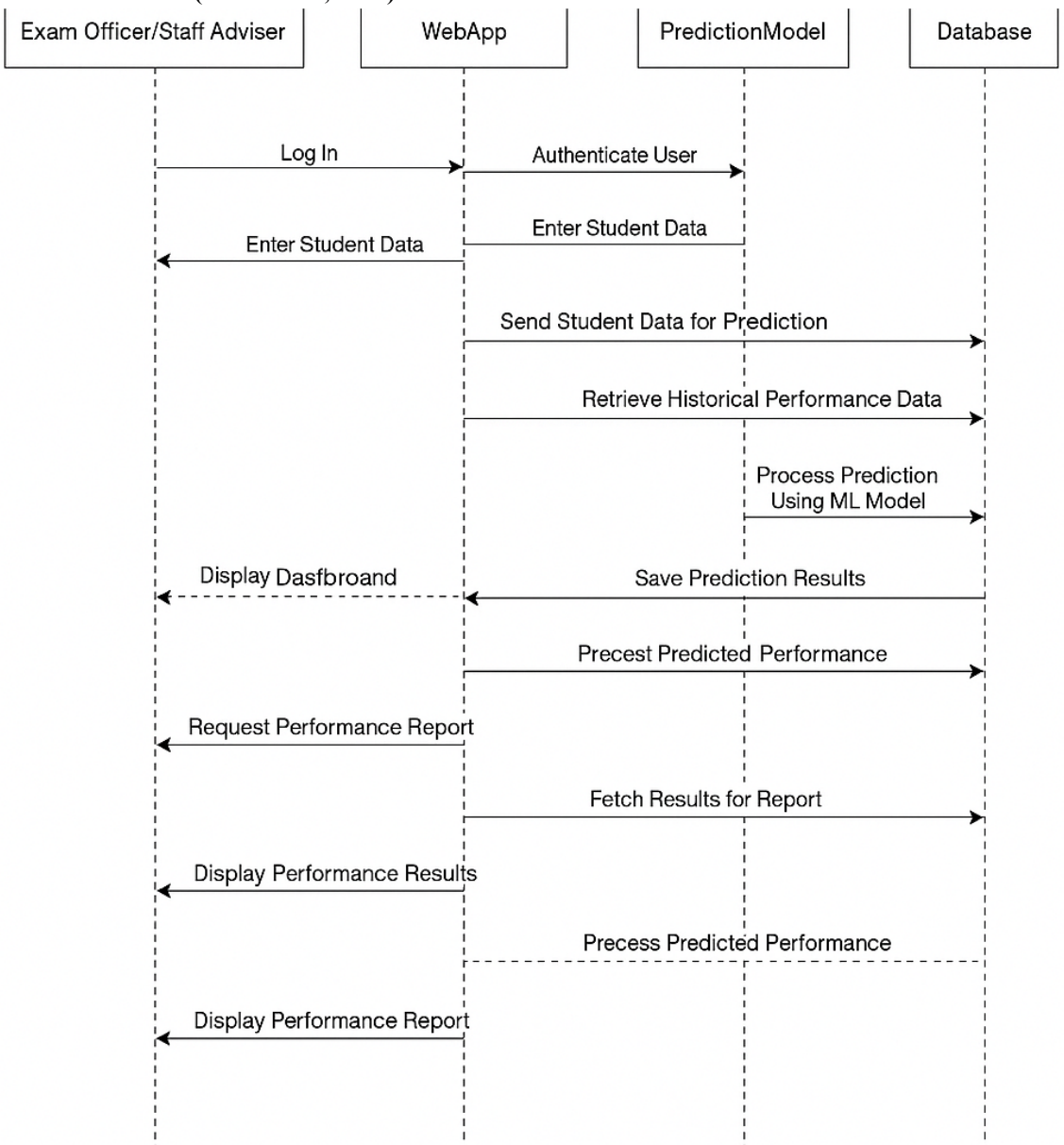


Figure 4: Entity-Relationship diagram

Source: (Researcher, 2024)



Source: (Researcher, 2024)

In this diagram, the Exam Officer/Staff Adviser logs into the web application, where their credentials are authenticated by the database. Upon successful authentication, they are presented with a dashboard. The Exam Officer/Staff Adviser enters student data, which is validated by the system and sent to a machine learning model for prediction. The model retrieves relevant historical data from the database, processes the prediction using algorithms, and returns the results. The prediction is saved to the database and displayed to the Exam Officer/Staff Adviser. Additionally, the Exam Officer/Staff Adviser can request a performance report, which is generated by fetching data from the database and displayed on the web application.

The area of the study was South-South Nigeria. South-South Nigeria is one of the six geopolitical zones in the country, comprising six states: Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers. The population of the study consisted of 9934 lecturers comprising of

Examination Officers, Staff Advisers and other lecturers in Federal Universities in South-South, Nigeria, during 2021/2022 academic session. A sample size of 397 lecturers which consisted of 198 Examination Officers and 199 Staff Advisers were selected for the study. Twenty Four percent of the population was used as sample size using Taro Yamane formula. Purposive random sampling technique was used to select the sample size for the study. The participants were chosen based on specific criteria relevant to the study's hypotheses. In this case, the criterion was that the lecturers have to be Examination Officers or Staff Advisers. This approach ensures that the sample was directly aligned with the study's purpose, focusing only on those individuals who meet the necessary conditions. A researcher made instrument entitled Usability of Machine Learning based Software Questionnaire **(**UMLBSQ**)** was used in collecting data for analysis. The instrument contained items on lecturers' usefulness, ease of use, social influence and satisfaction of machine learning based software for the prediction and classification of students' academic performance. The instrument was built on a four-point scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Face validation was conducted for the instrument. The instrument was given to three experts for validation. One of the experts was from the Department of Computer and Robotics Education, another from the Department of Industrial Technology Education and one was from Educational Evaluation in the Department of Psychological Foundations all in the University of Uyo. The corrections made were effected on the instrument before used in collecting data for the study. To determine the internal consistency reliability of the instrument, the instrument was administered to 50 lecturers in Federal Universities in South-East who were not part of the study population. Cronbach alpha Statistics was used to determine the reliability coefficient of the instrument and the reliability co-efficient was 0.87.

The researcher obtained permission from the administrators of the Universities. The experiment with the machine learning based software lasted for four weeks. The researcher employed the services of six research assistants. The researcher sensitized the research assistants on the use of the software, who in turn sensitized the lecturers on the use of the software. Copies of the questionnaire were administered to the lecturers who are examination officers and staff advisers by the research assistants to elicit information on the usefulness, ease of use, social influence and satisfaction of the Machine Learning Based software for prediction and classification of Students' Academic Performance in Federal Universities, South-South Nigeria. 351 copies of the questionnaire representing 88.16% were successfully retrieved, coded and ready for analysis. Data collected for the study were analyzed using mean and standard deviation to answer the research questions and independent t-test to test the null hypotheses. The research questions were answered using the following remarks: Mean score from 2.50 and above was be accepted as agree while mean scores below 2.50 was be taken as disagree.

RESULTS

This section presents the result of the data analyses based on the objectives and research questions of the study. The result of the analyses is presented in tables as shown below:

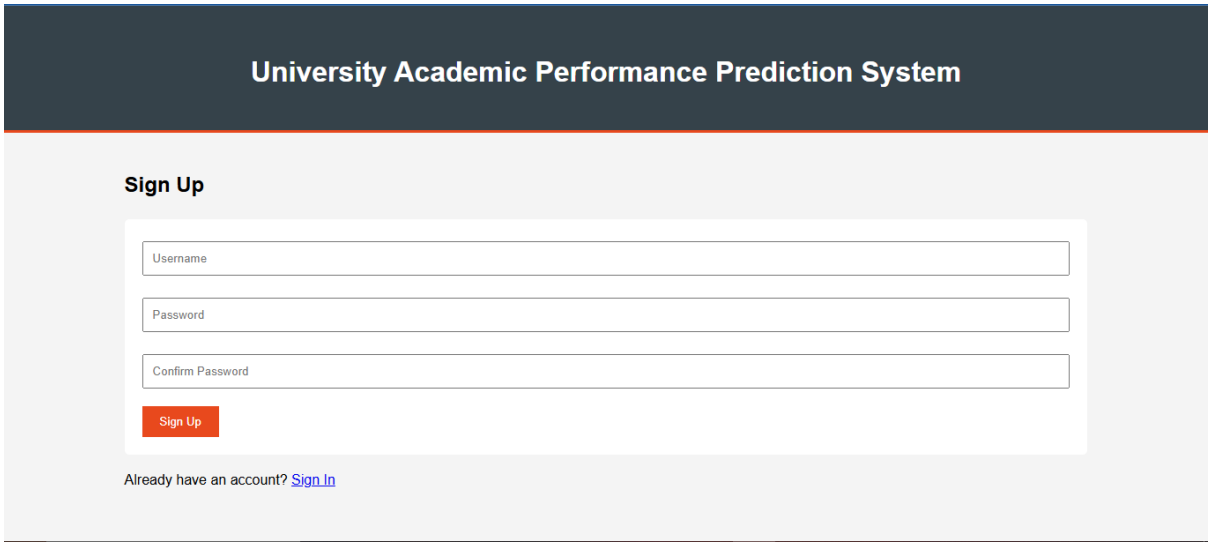
Development of the System

The Machine learning based software was fully developed in HTML, CSS, JAVASCRIPT, Python and PHP for standard web development. Python programming language was used to build the model.

The interfaces consist of several web pages and it has well styled fields with drop down menu and clickable buttons which performs several

functions such as sign in, sign up, submit etc for user satisfaction. The interfaces depend on each other as follow:

Sign Up Interface: This interface was created to enable users easily register with username and password on the system.



Source: Researcher (2024)

Sign In Interface: this interface was developed to allow registered users to easily log in to the system.

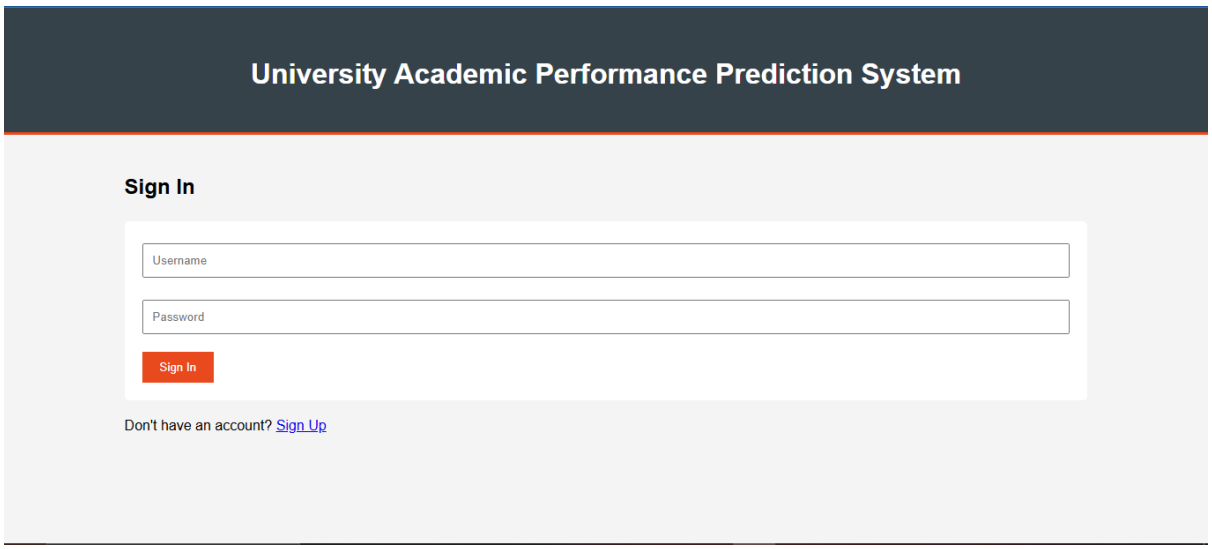


Figure 4.2: Sign In Interface
Source: Researcher (2024)

International Journal of Frontiers Research
DOI: 10.5281/zenodo
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Home Interface: this interface was created to enter the data of students for prediction based on the inputted data.

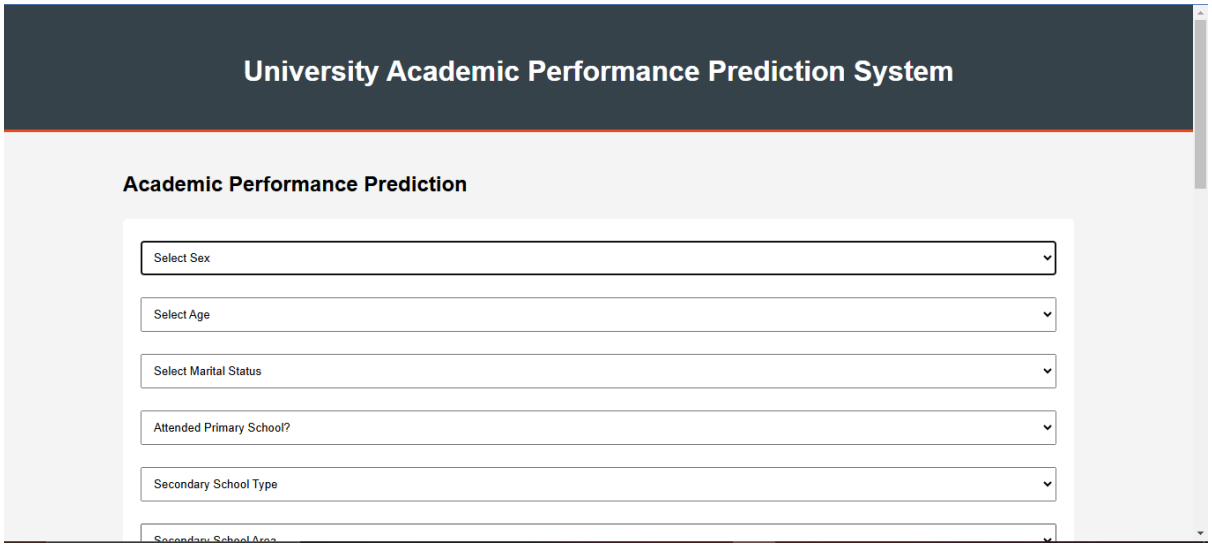

Figure 4.3: Home Interface
Source: Researcher (2024)

Report Interface: This interface was created to display and save the outcome resulting from running the prediction model.

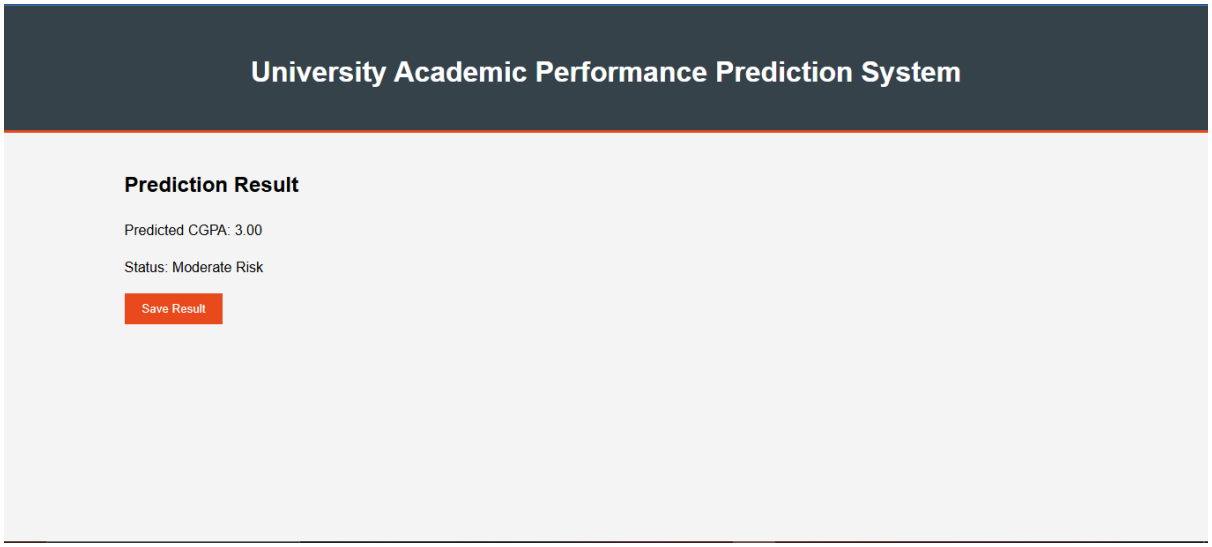

Figure 4.4: Report Interface
Source: Researcher (2024)

Research Question 1

What is the perceived usefulness of the Machine Learning software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria?

Table 1: Summary of mean responses on perceived usefulness of the Machine Learning software for Predictions and Classification of Students' Academic Performance

Items	Groups	N	Mean	SD	Remark
The Machine Learning software provides valuable insights into students' academic performance trends.	Examination Officers	172	3.37	0.583	Agree
	Staff Advisers	179	3.43	0.496	
The software's predictions are helpful in making informed decisions about academic support for students.	Examination Officers	172	3.46	0.678	Agree
	Staff Advisers	179	3.33	0.471	
The data generated by the software enhances the understanding of factors affecting student performance.	Examination Officers	172	3.51	0.680	Agree
	Staff Advisers	179	3.22	0.823	
The software aids in identifying areas where students may need additional academic assistance.	Examination Officers	172	3.30	0.796	Agree
	Staff Advisers	179	3.58	0.539	
The use of the software contributes to improved academic planning.	Examination Officers	172	3.28	0.450	Agree
	Staff Advisers	179	3.55	0.672	
The software's recommendations are relevant for enhancing students' academic outcomes.	Examination Officers	172	3.17	0.838	Agree
	Staff Advisers	179	3.39	0.611	
The insights from the software are useful for developing targeted interventions for struggling students.	Examination Officers	172	3.57	0.631	Agree
	Staff Advisers	179	3.27	0.506	
The software supports better academic forecasting future semesters.	Examination Officers	172	3.35	0.807	Agree
	Staff Advisers	179	3.37	0.860	
The software's functionality is aligned with the academic goals.	Examination Officers	172	3.33	0.823	Agree
	Staff Advisers	179	3.58	0.539	

The software's functionality is aligned with the needs of the institution.	Examination Officers	172	3.41	0.620	Agree
	Staff Advisers	179	3.48	0.767	

Source: Field data (2025)

The summary of the result of mean and standard deviation of examination officers and staff advisers on perceived usefulness of the Machine Learning software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria was presented in Table 1. The Table show that the perceived usefulness of the Machine Learning software for predictions and classification of students' academic performance in federal universities in South-South Nigeria was examined using responses from Examination Officers and Staff Advisers. Both groups generally agreed on the positive impact of the software, as indicated by their mean responses across various items.

The software was found to provide valuable insights into academic performance trends, with mean scores of 3.37 and 3.43 for Examination Officers and Staff Advisers, respectively. This indicates consensus on its capability to analyze and reveal trends in students' performance effectively. Additionally, the participants agreed that the predictions generated by the software are instrumental in making informed decisions about academic support, as evidenced by mean scores of 3.46 and 3.33 from Examination Officers and Staff Advisers, respectively.

The data produced by the software was perceived to enhance understanding of the factors affecting student performance, with Examination Officers rating this aspect slightly higher (mean = 3.51) than Staff Advisers (mean = 3.22). Furthermore, the participants acknowledged the role of the software in identifying areas where students may require additional academic assistance, with Staff Advisers (mean = 3.58) assigning a slightly higher mean score than Examination Officers (mean = 3.30). Similarly, its contribution to improved academic planning was positively rated by both groups, with mean scores of 3.28 for Examination Officers and 3.55 for Staff Advisers.

The relevance of the software's recommendations for enhancing students' academic outcomes also received positive feedback, with mean scores of 3.17 and 3.39 for Examination Officers and Staff Advisers, respectively. Additionally, the software was considered useful in developing targeted interventions for struggling students, as evidenced by the mean scores of 3.57 and 3.27 from Examination Officers and Staff Advisers. Its role in supporting academic forecasting for future semesters received similar agreement from both groups, with mean scores of 3.35 and 3.37.

The alignment of the software's functionality with institutional academic goals and needs was also recognized, as Examination Officers and Staff Advisers rated this aspect with mean scores of 3.33 and 3.58, and 3.41 and 3.48, respectively. Overall, the responses indicate strong agreement across all items that the Machine Learning software is a valuable tool for predictions, classifications, and supporting academic decision-making in federal universities in the South-South region of Nigeria.

Research Question 2

What is the ease of use of the Machine Learning software for Predictions and Classification of Students' Academic Performance in Federal Universities, South-South Nigeria.

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DOI: 10.5281/zenodo
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Table 2: Summary of mean responses on ease of use of the Machine Learning software for Predictions and Classification of Students' Academic Performance

Items	Groups	N	Mean	SD	Remark
The Machine Learning software is user-friendly.	Examination Officers	172	3.40	0.578	Agree
	Staff Advisers	179	3.45	0.521	
The software's interface is straightforward for users without extensive technical expertise.	Examination Officers	172	3.46	0.678	Agree
	Staff Advisers	179	3.33	0.471	
The process for inputting data into the software is simple.	Examination Officers	172	3.53	0.661	Agree
	Staff Advisers	179	3.26	0.810	
The software provides clear instructions for users.	Examination Officers	172	3.30	0.796	Agree
	Staff Advisers	179	3.58	0.539	
Learning to use the Machine Learning software requires minimal training.	Examination Officers	172	3.31	0.465	Agree
	Staff Advisers	179	3.57	0.653	
The software's functionalities are easy to access.	Examination Officers	172	3.20	0.821	Agree
	Staff Advisers	179	3.42	0.616	
The software performs tasks efficiently without frequent errors or crashes.	Examination Officers	172	3.58	0.630	Agree
	Staff Advisers	179	3.30	0.505	
It is easy to interpret the results provided by the software.	Examination Officers	172	3.38	0.781	Agree
	Staff Advisers	179	3.40	0.844	
The software allows for easy integration with existing academic data systems.	Examination Officers	172	3.32	0.822	Agree
	Staff Advisers	179	3.57	0.540	
The software's performance is reliable under different usage scenarios.	Examination Officers	172	3.41	0.620	Agree
	Staff Advisers	179	3.48	0.767	

Source: Field data (2025)

The summary of the result of mean and standard deviation of examination officers and staff advisers on ease of use of Machine Learning software for Predictions and Classification of

Students' Academic Performance in Federal Universities, South-South Nigeria was presented in Table 2. The Table show that the ease of use of the Machine Learning software for predictions and classification of students' academic performance in federal universities in South-South Nigeria was assessed through responses from Examination Officers and Staff Advisers. Both groups generally expressed agreement regarding the software's usability, as reflected in the mean scores across all evaluated items.

The software was perceived as user-friendly, with Examination Officers and Staff Advisers assigning mean scores of 3.40 and 3.45, respectively. This suggests a shared positive view of its intuitive design and accessibility. Similarly, the straightforwardness of the interface for users without extensive technical expertise was acknowledged, with mean scores of 3.46 and 3.33, indicating that the software caters to users with varying levels of technical skills.

The process for inputting data into the software was considered simple, as shown by mean scores of 3.53 and 3.26 from Examination Officers and Staff Advisers. Both groups also agreed that the software provides clear instructions for users, with Staff Advisers rating this aspect slightly higher (mean = 3.58) than Examination Officers (mean = 3.30). Learning to use the software was reported to require minimal training, with mean scores of 3.31 for Examination Officers and 3.57 for Staff Advisers.

Participants also found the software's functionalities easy to access, as reflected in mean scores of 3.20 and 3.42. The efficiency of the software in performing tasks without frequent errors or crashes was highlighted, with Examination Officers assigning a higher mean score of 3.58 compared to 3.30 from Staff Advisers. Additionally, interpreting the results provided by the software was deemed straightforward, with similar mean scores of 3.38 and 3.40 for Examination Officers and Staff Advisers.

The software's ability to integrate easily with existing academic data systems was positively rated, with Examination Officers giving a mean score of 3.32 and Staff Advisers assigning a slightly higher mean score of 3.57. Lastly, the reliability of the software under different usage scenarios received favorable evaluations, with mean scores of 3.41 and 3.48 from Examination Officers and Staff Advisers, respectively. Overall, the results indicate that the Machine Learning software is perceived as easy to use, with features and functionalities that align well with user needs in academic environments.

DISCUSSION OF FINDINGS

The study successfully developed a Machine Learning (ML)-based software system for the prediction and classification of students' academic performance in Federal Universities in South-South Nigeria. The software was designed using modern web development technologies, including HTML, CSS, JavaScript, Python, and PHP. The core machine learning component utilized a Random Forest algorithm, trained to predict students' academic outcomes based on data inputs such as demographic details, academic histories, and support levels. The development followed the Rapid Application Development (RAD) methodology, which emphasized iterative prototyping and user feedback, ensuring the software was tailored to the needs of Examination Officers and Staff Advisers.

The software's interfaces, including Sign Up, Sign In, Home, and Report modules, were designed for ease of navigation and functionality. The integration of the backend (Python machine learning scripts) with the frontend ensured seamless data processing and result display. The structured and user-centric design aligns with best

practices in software engineering, particularly in educational technologies, which prioritize usability and functionality. The development process aligns with principles of the Technology Acceptance Model (TAM) and Diffusion of Innovations Theory. TAM emphasizes perceived usefulness and ease of use as determinants of technology adoption, while the Diffusion of Innovations Theory highlights the importance of relative advantage and simplicity. By focusing on user-friendly interfaces and leveraging predictive analytics to provide actionable insights, the software addresses these theoretical underpinnings, promoting widespread acceptance among academic staff.

Additionally, the choice of the Random Forest algorithm reflects best practices in educational data mining, as ensemble learning methods are known for their robustness and accuracy in handling complex datasets. Previous studies finding by Woolf et al. (2023), support the use of similar algorithms in predicting academic outcomes, reinforcing the validity of the methodological choices made in this study.

The successful development and integration of this software align with findings from related studies. The integration of predictive technologies in education has shown significant promise in tailoring interventions to individual student needs. Chen et al. (2020) emphasized how adaptive systems leverage predictive analytics to personalize learning pathways, thereby addressing diverse student requirements more effectively. This aligns with the findings of Campbell and Oblinger (2017), who demonstrated that institutions employing predictive models observed measurable improvements in student retention rates. Together, these studies underscore the transformative potential of data-driven approaches in education—not only for academic support but also for institutional decision-making. These parallels underscore the potential of the developed software to address challenges such as early identification of at-risk students and improved academic planning.

Despite the successful development, challenges such as ensuring data quality, mitigating bias, and safeguarding data privacy were critical considerations. The study implemented preprocessing steps and anonymization techniques to address these concerns, but the effectiveness of such measures depends on ongoing system evaluation and updates. Additionally, the reliance on specific data points (e.g., demographic and academic history) may limit the software's applicability across diverse educational contexts without further customization.

The developed software has significant implications for educational practice. It equips Examination Officers and Staff Advisers with tools to analyze performance trends, identify students needing support, and make data-driven decisions. These functionalities can enhance the quality of academic interventions, improve retention rates, and support institutional planning. The system also provides a scalable solution, offering opportunities for future integration with other academic systems to broaden its impact.

The successful development of this ML-based software demonstrates the feasibility and utility of integrating predictive analytics into educational practices. By adhering to established theoretical frameworks and leveraging robust methodologies, the study contributes to addressing the unique challenges of student academic performance in Federal Universities in South-South Nigeria. Future efforts should focus on expanding the system's capabilities and addressing any limitations to maximize its effectiveness.

The findings reveal that both Examination Officers and Staff Advisers perceive the Machine Learning software as useful for predicting and classifying students' academic performance in Federal Universities in South-South Nigeria. The responses indicate that the software provides

valuable insights into performance trends, aids in making informed decisions regarding academic support, and enhances understanding of factors affecting performance. These align with the Technology Acceptance Model (TAM), which posits that perceived usefulness significantly influences technology adoption. Respondents noted its utility in identifying students who may require additional academic assistance, supporting academic planning, and providing recommendations that contribute to improved outcomes. This aligns with Adeniyi *et al.,* (2022) and Sánchez-Prieto et al., (2020) earlier literature emphasizing the role of predictive analytics in enabling timely, data-driven interventions to enhance academic success.

The findings are consistent with studies highlighting the value of machine learning tools in education. Yagci (2022) demonstrated that machine learning algorithms like Random Forest and Neural Networks effectively predict student performance, providing actionable insights for educators. Similarly, Abou *et al.* (2023) found that Neuro-fuzzy models offered precise analyses of academic factors. These parallels underscore the utility of machine learning systems in supporting academic planning and interventions, as perceived by respondents in this study.

Contrastingly, some studies, such as Melissa *et al.* (2022), suggest that non-machine learning approaches, like qualitative academic advising, can also provide meaningful guidance. The differences in methodologies between traditional and algorithmic systems may explain these variations, with machine learning offering scalability and precision that qualitative methods might lack. The findings validate the Technology Acceptance Model's assertions regarding perceived usefulness as a driver of adoption. The shared positive perceptions among stakeholders indicate that the software aligns with users' needs, offering measurable advantages over traditional methods of academic assessment. Moreover, the Diffusion of Innovations Theory underscores the importance of relative advantage in adoption rates. The software's ability to simplify complex performance analyses and provide real-time insights likely contributed to its positive reception.

The significant difference noted in one item suggests potential variability in how user roles influence perceptions of usefulness. This divergence could be attributed to differences in how Examination Officers and Staff Advisers engage with student performance data. Further exploration of these role-specific dynamics may clarify the finding and guide tailored training or implementation strategies. Overall, the findings reinforce the software's perceived value in enhancing academic outcomes, consistent with global trends in educational data mining. By addressing gaps in traditional assessment methods, such tools can improve decision-making, foster timely interventions, and ultimately, contribute to better educational experiences for students.

The findings indicate that both Examination Officers and Staff Advisers perceive the Machine Learning software as easy to use, highlighting its intuitive design, user-friendly interface, and straightforward functionality. Key aspects such as simplicity in data input, clarity of instructions, and minimal training requirements were positively rated, reflecting a consensus on the software's accessibility. This aligns with the Technology Acceptance Model (TAM), which emphasizes perceived ease of use as a critical determinant of technology adoption. The software's ability to facilitate smooth navigation and efficient task performance without requiring extensive technical expertise supports its usability in academic environments.

The findings align with Hanafizadeh *et al.* (2014), who emphasized the importance of user-friendly interfaces in promoting sustained technology use. Similarly, Sánchez-Prieto *et al.* (2020), highlighted that intuitive design and minimal operational effort significantly enhance

the acceptance of educational technologies. However, these results contrast with Tahar *et al.* (2020), which found that perceived ease of use did not strongly influence the adoption of e-filing systems. This discrepancy may stem from contextual differences, as academic environments place a higher premium on usability due to the diversity in user technical skills.

| Conclusion

From the findings obtained from the study, it could be concluded that development of machine learning software for prediction and classification of students' academic performance in Federal Universities in South-South Nigeria shows perceived usefulness and ease of use of the system. Social influence was a factor in the use of new technology in an institution. It is therefore very important that examination officers and staff advisers in Federal Universities, South-South Nigeria be encouraged to uphold good perception towards the use of Machine Learning software for Predictions and Classification of Students' Academic Performance so as to help students to improve in their studying pattern based on the outcome of the machine learning based software prediction.

| Educational Implications of Findings

The findings of the study carry significant educational implications for various stakeholders, including students, teachers, parents, administrators, policymakers, and the school as an institution. For students, the Machine Learning software provides opportunities for early identification of academic challenges, enabling timely interventions to improve their performance. The predictive insights generated by the software can guide students in focusing on specific areas where improvement is needed, fostering a more targeted and effective learning approach.

For teachers, the software offers a valuable tool for understanding individual student needs and tailoring instructional strategies accordingly. By leveraging predictive analytics, teachers can identify at-risk students early and implement remedial measures to address potential issues. This enhances the overall teaching process and ensures that every student receives adequate support to achieve their academic goals.

Parents also benefit from the findings, as the software's insights provide a clearer picture of their children's academic progress. The ability to access detailed reports on performance trends and influencing factors empowers parents to engage more effectively in their children's education. This fosters better communication and collaboration between parents and schools in supporting student success.

For administrators, the study highlights the potential of data-driven decision-making to improve academic planning and resource allocation. The software's ability to analyze performance trends and classify students based on academic needs supports evidence-based strategies for enhancing institutional effectiveness. It also aids in monitoring the overall performance of the school, ensuring that policies and practices align with educational goals.

Policymakers can draw on the findings to advocate for the integration of technology in education. The demonstrated effectiveness of the Machine Learning software underscores the importance of investing in predictive analytics tools to improve educational outcomes. Policymakers can use these insights to develop frameworks for adopting similar technologies across schools, promoting innovation in the education sector.

For the school as an institution, the findings suggest that adopting Machine Learning software can enhance the quality of education provided. The ability to identify performance gaps, predict future outcomes, and implement targeted interventions strengthens the institution's reputation for academic excellence. Additionally, the use of technology aligns with global trends in education, ensuring that the school remains

competitive and forward-thinking. The findings emphasize the transformative potential of Machine Learning technology in education. These implications underscore the importance of embracing technological innovations to achieve holistic educational development.

Recommendations

The following recommendations are made based on the findings of the study.

i. Students should engage with the predictions and classifications to set achievable goals and improve study strategies for better academic outcomes.
ii. Lecturers should incorporate the software's predictive results into lesson planning and classroom interventions to address individual student needs effectively. The lecturers should use the data-driven insights to develop targeted remedial programs for at-risk students. Also, lecturers should provide feedback to administrators on the usability and functionality of the software to improve its adoption and effectiveness.
iii. Administrators should integrate the Machine Learning software into the institutional framework for monitoring academic performance and planning interventions. Administrators should as well allocate resources for periodic training sessions to ensure teachers and staff maximize the software's capabilities. Also, regularly evaluate the software's impact on academic outcomes and refine its usage to align with institutional goals.
iv. Policymakers should formulate policies that promote the adoption of Machine Learning and other predictive analytics tools in educational institutions. Also, provide funding and infrastructure to support the implementation of such technologies in schools across the country.
v. Parents should participate in school-organized orientations on how to interpret and use the data provided by the software for informed parental involvement.

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