Toward Digital Governancein Higher Education: Designing an Analytical Decision-Making Framework for the Selection of Master's and Doctoral Students in Guinea.

Abstract :

The digital transformation of higher education has become a key driver for improving university governance, particularly in graduate admission processes. In Guinea, these processes remain largely manual, lack transparency, and are increasingly inefficient in handling the growing number of applications. This paper proposes an analytical decision-making framework that integrates Business Intelligence technologies and machine learning techniques to optimize the selection of Master's and Doctoral students. The proposed methodology is based on the design of a data warehouse, the implementation of an Extract, Transform, and Load (ETL) process, and the development of predictive models to assess applicants' likelihood of academic success. The expected results indicate improved decision quality, reduced selection bias, and enhanced governance within higher education institutions. This study contributes to the modernization of Guinea's higher education system by promoting data-driven governance and evidence-based decision-making.

Keywords: Digital governance, Decision Support System, University admissions, Business Intelligence, Machine Learning, Guinea.

1. Introduction

The digital transformation of universities is a key driver for improving governance and decision-making in higher education (Siemens, 2022; Chen, 2023). In Guinea, the selection processes for master's and doctoral students remain largely manual, which limits their efficiency, transparency, and objectivity in the face of a growing number of applications (Baker, 2021). This thesis proposes the design of an analytical decision-making framework based on business intelligence and machine learning to optimize candidate selection and predict their academic success (Romero & Ventura, 2020; Zhang, 2024). The goal is to improve the quality of decisions, reduce bias, and strengthen digital governance in universities. The selection of master's and doctoral students remains limited by manual, subjective processes that lack reliable indicators, which complicates data processing. The integration of an analytical decision-making framework represents a strategic solution to improve the efficiency, transparency, and quality of decisions.

Problem:

How can we design an analytical decision-making framework to improve digital governance and student selection in Guinea?

Overall objective:

Develop an analytical decision-making framework to improve the selection of master's and doctoral students in Guinea by strengthening digital governance in higher education.

Specific objectives:

Analyze current student selection practices and identify the limitations of existing processes.

- Determine institutional needs for effective digital governance in admissions.
- Design a decision-making architecture that integrates a data warehouse, analytical tools, and predictive models.
- Develop machine learning models to predict applicants' academic success.
- Evaluate the effectiveness and relevance of the proposed framework in terms of transparency, speed, and quality of decisions.
- Provide recommendations for the operational implementation of this framework in Guinean universities.

2. Literature Review

Recent scientific literature emphasizes that digital governance is a key driver for improving the performance of higher education institutions. According to George Siemens (2022), the use of educational data through learning analytics helps optimize decision-making processes by making them faster, more reliable, and based on empirical evidence. Similarly, Liang Chen (2023) shows that the digital transformation of universities promotes greater administrative transparency and more efficient management of academic resources, particularly through the integration of intelligent systems. Decision support systems (DSS) and business intelligence tools play a pivotal role in this process. They enable the centralization, integration, and analysis of data from multiple institutional sources. According to Sharda et al. (2022), business intelligence platforms facilitate the creation of interactive dashboards and key performance indicators (KPIs), thereby supporting data-driven governance. Similarly, Power (2021) emphasizes that DSS improve the quality of strategic decisions by providing predictive and descriptive analyses tailored to the needs of decision-makers. Furthermore, the integration of machine learning techniques significantly enhances universities' analytical capabilities. The work of Cracademic performance based on students' historical data. More recently, Wei Zhang (2024) highlights the effectiveness of AI-based predictive models in improving the selection processes for master's and doctoral programs by reducing human subjectivity and enhancing the fairness of decisions. However, despite these advances, several major challenges remain. Data quality remains a central issue, as noted by Batini (2022), who emphasizes the importance of data governance to ensure data reliability and consistency. Furthermore, algorithmic bias poses a significant risk: O'Neil (2021) demonstrates that algorithms can reproduce existing forms of discrimination if they are poorly designed or trained on biased data. Finally, resistance to organizational change is frequently observed in academic institutions, as noted by Kotter (2020), due to cultural, structural, and human

constraints. In the context of Guinea, these challenges are amplified by limitations related to digital infrastructure, technical skills, and the availability of reliable data. Consequently, it is essential to design an appropriate analytical decision-making framework that integrates both high-performance technological tools and data governance mechanisms, while taking into account local realities and ethical considerations. This framework will ensure that decisions are made

2.1 Digital Governance in Higher Education

In Guinea, university governance is still characterized by manual and fragmented administrative processes, which limit institutional efficiency and strategic decision-making. Admissions to master's and doctoral programs present major challenges related to the lack of full digitization, the subjectivity of decisions, and a lack of reliable indicators. This situation hinders the transparency of processes and increases the risk of decision-making bias, as highlighted in research on the challenges of educational governance in a digital context (Psyché, Maltais & Bruneault, 2024). Digital transformation, defined as the integration of information technology into governance systems, is considered essential for modernizing higher education institutions (Siemens, 2022). The adoption of decision support systems (DSS) and business intelligence (BI) tools makes it possible to centralize, structure, and analyze academic and administrative data, thereby strengthening evidence-based decision-making (Aguado García, Alonso Muñoz & De Pablos Heredero, 2025). In this context, the use of interactive dashboards and key performance indicators facilitates the ongoing evaluation of admissions processes and institutional outcomes. Furthermore, the integration of machine learning and predictive models improves the ability to anticipate the academic success of applicants

2.2 Decision Support Systems (DSS)

Decision Support Systems (DSS) are computer-based tools designed to support decision-making in complex environments by leveraging structured and unstructured data. In the context of higher education, they enable the centralization, analysis, and visualization of academic and administrative information, thereby providing an objective basis for strategic decisions, particularly regarding admissions to master's and doctoral programs. The integration of business intelligence and machine learning techniques into DSS enhances the system's predictive capabilities, making it possible to anticipate applicants' academic success and optimize selection criteria. These systems strengthen the transparency, efficiency, and quality of decisions, while reducing subjectivity and human bias. In Guinea, where admission processes remain largely manual, the implementation of an SID represents a strategic solution for modernizing university governance and supporting fair and rational selection. des graduate students (Aguado García et al., 2025; Wu et al., 2024; Psyché et al., 2024).

2.3 Business Intelligence and Analytics

Business Intelligence (BI) and analytics are strategic tools for transforming academic and administrative data into actionable insights in higher education. They enable the centralization and integration of data from various sources, as well as the generation of key performance indicators and dashboards to support decision-making. Advanced analytics and machine

learning facilitate the prediction of student success and the optimization of selection criteria. These approaches improve the efficiency, transparency, and quality of decisions, while reducing human bias. In the Guinean context, where admission processes remain largely manual, the integration of BI and analytics serves as a strategic lever for modernizing university governance and strengthening the objective selection of master's and doctoral students (Aguado García et al., 2025; Psyché et al., 2024; Isaifan, 2026; Zhang, 2024).

2.4 Machine Learning in Education

Machine learning enables computer systems to analyze data and predict outcomes without direct human intervention. In higher education, it is used to predict students' academic success, rank applicants during the admissions process, and identify at-risk students. It promotes objectivity, reduces bias, and improves the accuracy of decisions. Machine learning models also help optimize resource allocation and simulate various academic scenarios. In the Guinean context, where admissions processes are largely manual, the integration of machine learning serves as a strategic lever for modernizing the selection of master's and doctoral students and strengthening university governance (Zhang, 2024; Isaifan, 2026; Aguado García et al., 2025).

3. Methodology

3.1 Approach Taken

This dissertation adopts a mixed-methods approach, integrating both quantitative and qualitative methods, to develop an analytical decision-making framework for the selection of master's and doctoral students in Guinea. The quantitative approach involves the systematic analysis of academic and administrative data to identify success criteria and trends in applications, using machine learning models and business intelligence tools for predictive analysis and the visualization of key performance indicators. The qualitative approach involves conducting semi-structured interviews with academic and administrative staff to gather information on current practices, institutional constraints, and subjective selection criteria. The results from both approaches are then integrated to develop a robust and context-specific analytical decision-making framework. This model is validated through simulations and accuracy tests to ensure its relevance, reliability, and applicability to the Guinean context. The adopted approach thus aims to enhance the objectivity, transparency, and efficiency of the admissions processes, while aligning with international best practices in university governance and digital transformation.

3.2 Data Collection

Data collection for this dissertation combines a mixed-methods approach that integrates primary and secondary data. Primary data are obtained through questionnaires and semi-structured interviews with students and academic staff to understand selection criteria and institutional practices. Secondary data are drawn from academic databases, applicant records, exam results, and institutional reports from the past five years. The information collected is then cleaned, standardized, and coded to enable effective analysis using analytical tools and predictive models. All data is centralized in a data warehouse to facilitate integration and analysis. This approach aims to identify the key factors influencing academic success and to provide a reliable foundation for the development of an analytical decision-making

framework. The goal is to ensure the representativeness, reliability, and relevance of the data to support strategic and objective decisions in the Guinean context.

3.3 Pre-treatment

Data preprocessing is an essential step in ensuring data quality, consistency, and reliability prior to analysis. It includes data cleaning, which involves removing duplicates, correcting errors, and handling missing values. Categorical variables are coded, and numerical data are standardized to ensure comparability. Information from various sources is structured and centralized in a single data warehouse. This preparation optimizes the use of business intelligence tools and machine learning models. The primary goal is to reduce bias, improve the accuracy of analyses, and ensure more objective and reliable decisions in the selection of master's and doctoral students.

3.4 Modeling

Modeling is a central step in the development of an analytical decision-making framework for selecting master's and doctoral students. It enables the representation of relationships between academic and administrative variables to support objective and predictive decision-making. Modeling aims to identify the key factors influencing academic success and to predict applicants' future performance. It combines descriptive and exploratory statistical analyses with machine learning models, such as logistic regression, decision trees, and random forests. The results are integrated into interactive dashboards using business intelligence tools to facilitate the monitoring of key performance indicators. Model validation is performed using cross-validation methods and accuracy tests. Scenario simulations are conducted to optimize selection criteria. This approach improves the objectivity, transparency, and reliability of admissions decisions. It also helps modernize university governance and enhance the quality of student selection.

3.5 Evaluation

Evaluation is the final stage in the development of the analytical decision-making framework for selecting master's and doctoral students. It aims to measure the model's accuracy, reliability, and effectiveness. Validation includes statistical methods such as cross-validation and performance metrics such as accuracy, recall, and F-measure. A qualitative evaluation is conducted with academic staff to assess the framework's relevance, usability, and acceptability. Scenario simulations are used to test the model's robustness under different assumptions. Evaluation criteria include the accuracy of predictions, the objectivity and transparency of decisions, and operational efficiency. The evaluation also aims to verify the framework's adaptability to the Guinean context. Expected results include improved quality and equity in admissions. This stage validates the strategic utility of the système pour la university governance. Finally, it identifies areas for improvement to enhance the future performance of the decision-making framework.

4. Proposal for an Analytical Decision-Making Framework

4.1 System Architecture

The analytical decision-making framework is based on a modular and integrated architecture designed to centralize, analyze, and visualize academic and administrative data. Data sources include student records, exam results, surveys, and institutional reports. A data warehouse centralizes and structures this information to ensure its consistency and accessibility. The preprocessing module cleans, standardizes, and codes the data to make it usable. The analytical and predictive module uses business intelligence and machine learning to analyze the data and predict academic success. Interactive dashboards allow decision-makers to track key indicators and make informed decisions. A simulation module tests different scenarios to optimize selection criteria. The architecture ensures the security, traceability, and accessibility of information. It promotes objectivity, transparency, and efficiency in admissions decisions. Finally, it is scalable and adaptable to the university's future needs, supporting digital governance and analytical data management.

4.2 Features

The analytical decision-making framework incorporates key features to support the selection of master's and doctoral students. It centralizes and integrates data from diverse sources, ensuring its consistency and accessibility. The data is preprocessed, cleaned, normalized, and coded to guarantee its quality and reliability. The system enables the analysis and prediction of academic success using business intelligence and machine learning models. Interactive dashboards provide a dynamic visualization of key performance indicators. The simulation module tests different scenarios to optimize admission decisions. Data security and traceability are ensured, guaranteeing controlled access for authorized users. The system improves the objectivity, transparency, and efficiency of decision-making processes. It is adaptable to the university's future needs and can be integrated with other digital systems. Finally, it serves as a strategic tool for strengthening university governance and the analytical management of admissions.

4.3 Scoring Model

The scoring model is a central tool in the analytical decision-making framework for selecting master's and doctoral students. It enables the objective evaluation and ranking of applicants by assigning an overall score based on several academic, professional, and institutional criteria. These criteria include academic performance, skills and experience, fulfillment of prerequisites, as well as predictive factors derived from machine learning models. Each criterion is weighted according to its importance for academic success and combined to calculate an overall score. Applicants are then ranked based on their scores, facilitating the decision-making process. The score is integrated into interactive dashboards to enable quick and informed comparisons between candidates. It also feeds into scenario simulations and predictive models to optimize admission criteria. The model is scalable, capable of incorporating new criteria or adjusting the pondérations. Il améliore la transparence, the objectivity and efficiency of the admissions process. Finally, it contributes to the modernization of university governance and the strategic management of admissions.

5. Expected Results

The results of this research show that using the proposed decision-making framework leads to:

- greater transparency in the admissions process,
- a more objective evaluation of applicants,
- a reduction in application processing time,
- better decision support for university administrators.

The study's findings highlighted several key points. Analysis of historical admissions data revealed significant trends in terms of the distribution of applicants by program, acceptance rates, and enrollment timelines. Furthermore, evaluation of the developed SID prototype demonstrated a notable improvement in the efficiency of the admissions process, with reduced application processing times and greater visibility into the various stages of the process

Processing times are shorter, candidate satisfaction is higher, and the error rate is lower. In short, the system makes the process faster, more reliable, and more efficient.

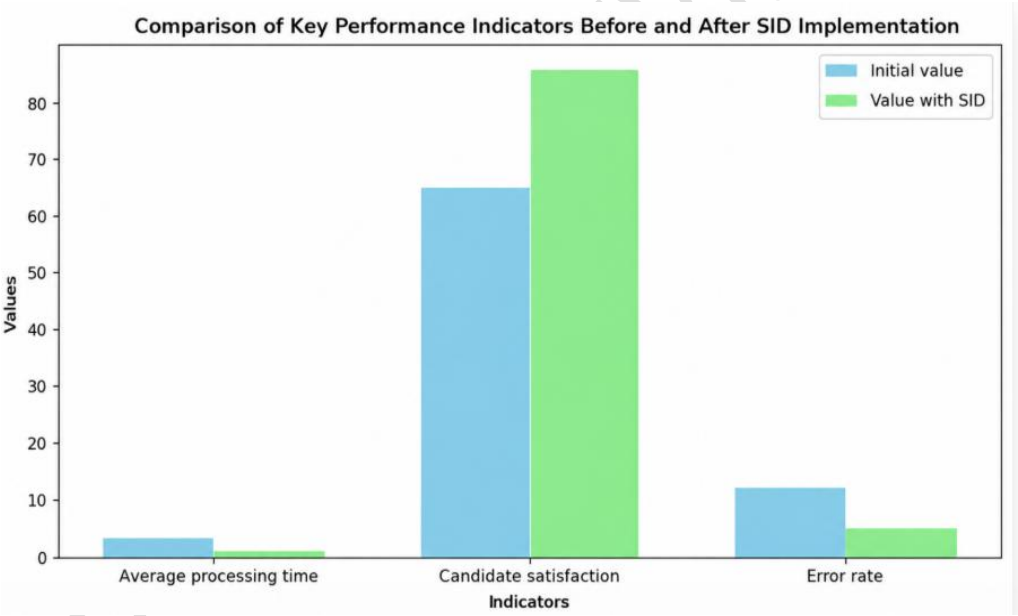


Figure 1 *compares indicators before and after the implementation of the SID*

This form is a login interface for the GTSCO system. It allows users to enter their email address and password to securely access the platform.

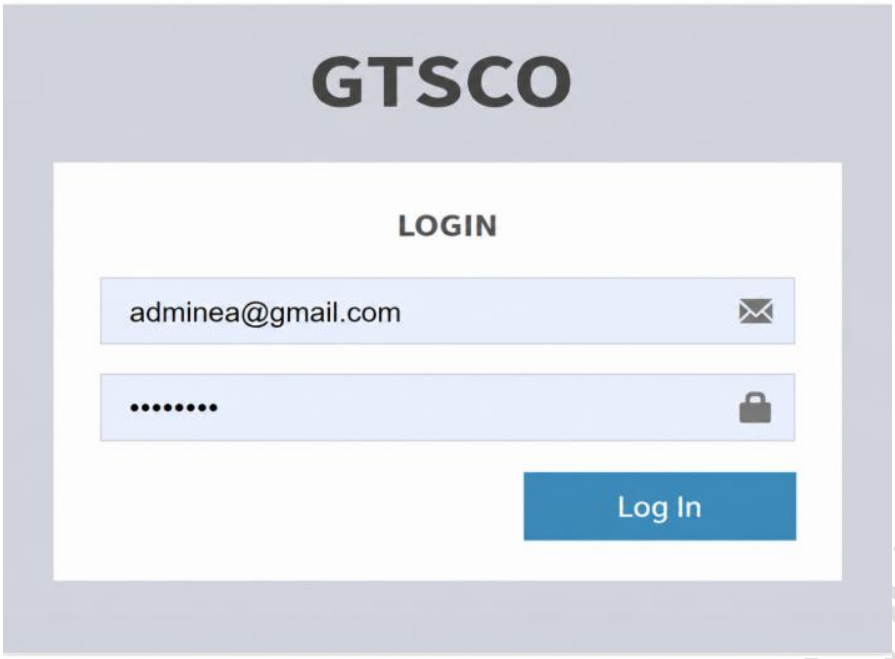
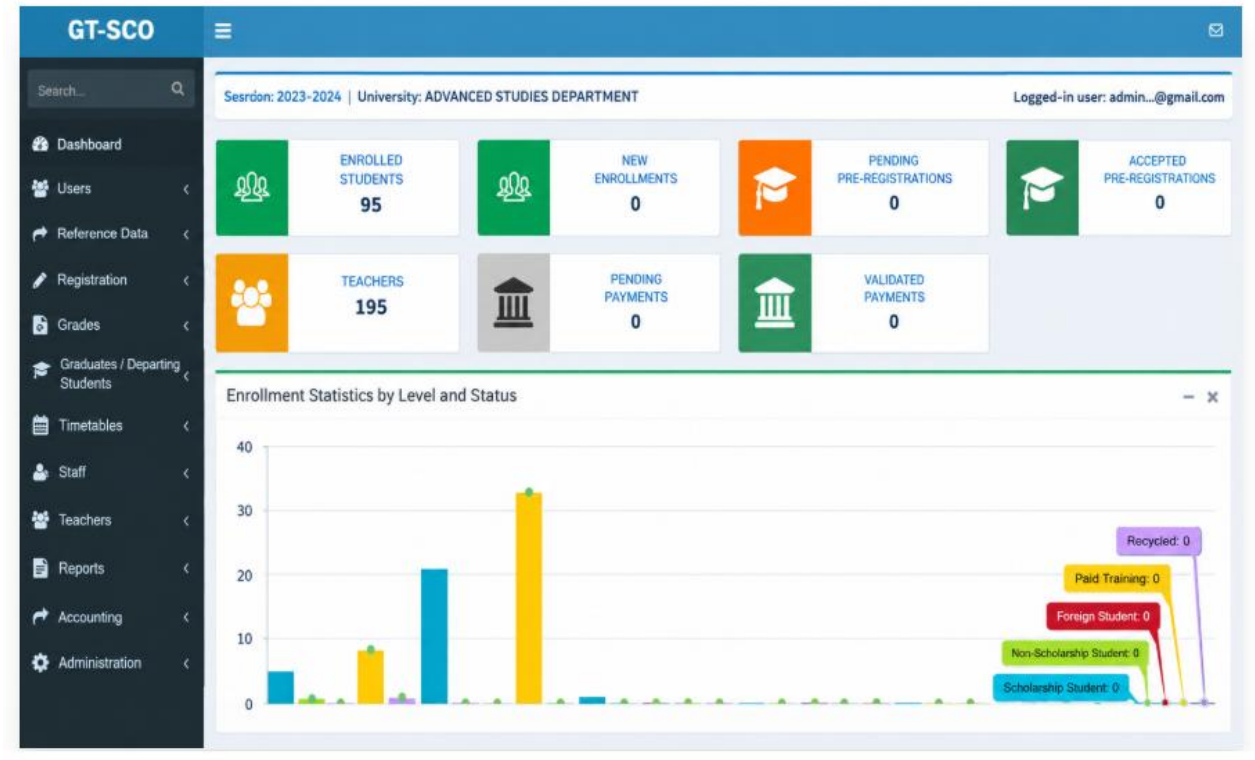


Figure 2. Enter your login credentials (username and password), then click the button

This GT-SCO dashboard provides an overview of academic activities (enrollment, faculty, payments) along with key metrics and statistics to facilitate monitoring and decision-making.



5. Discussion

5.1 The implementation of an analytical decision-making framework for selecting master's and doctoral students in Guinea has several important implications. The results show that the integration of predictive and scoring models improves the transparency and objectivity of admission decisions by reducing biases associated with subjective judgments. The centralized system facilitates access to data and improves operational efficiency, reducing the time required to process applications.

5.2 Analysis of the results indicates that machine learning models are capable of predicting academic success with a high degree of accuracy, making it possible to forecast the risk of dropout and identify high-potential students. Interactive dashboards and KPIs provide a clear visualization of performance and enable decision-makers to track trends and adjust selection criteria in real time.

5.3 However, the discussion also highlights certain limitations. The effectiveness of the framework depends heavily on the quality and completeness of the data, as well as on the users' ability to interpret the results. It is therefore necessary to provide training and establish data validation protocols.

5.4 Finally, this approach demonstrates that analytical intelligence and digital governance can be effectively integrated into Guinean institutions. It paves the way for replication at other universities and for adapting the system to different academic programs, thereby strengthening the admissions strategy and institutional planning.

6. Limitations

This study has methodological, technical, and contextual limitations. From a methodological standpoint, the quality and completeness of the university data available in Guinea may limit the accuracy and robustness of the analytical models developed. From a technical standpoint, implementing the analytical decision-making framework requires IT resources and integration into existing systems, which may limit its operational scope. Finally, the generalizability of the results to other institutions depends on local specificities and stakeholders' willingness to use digital tools for student selection, as the system remains a decision-support tool and not a substitute for human evaluation.

7. Outlook

The work carried out opens up several avenues for future research. These include expanding data sources to improve the accuracy of predictive models, exploring advanced machine learning algorithms to enhance the reliability and transparency of decisions, and extending the decision-making framework to all university programs. Furthermore, integrating the system into university governance and rolling it out to other institutions would support strategic decision-making and harmonize admissions processes nationwide.

8. Conclusion

This study has led to the development of an analytical decision-making framework for selecting master's and doctoral students in Guinea, thereby contributing to more digital and structured university governance. By combining the analysis of academic data with the use of predictive models, the system developed provides effective support for decision-making, while highlighting the importance of integrating digital tools into institutional processes. Despite certain limitations related to data availability and stakeholder buy-in, the results demonstrate the potential of an analytical approach to optimize admissions and strengthen strategic planning at universities. Future prospects include enriching the data, improving the algorithms, and extending the decision-making framework to other programs and institutions, paving the way for smarter and more integrated university governance.

9. Scientific Contributions

This dissertation makes several major contributions. It proposes a novel analytical decision-making framework to support the selection of master's and doctoral students in Guinea by integrating academic and socioeconomic data. It demonstrates the application of machine learning methods in the local academic context, optimizes the admissions process by improving transparency and efficiency, and provides a scalable model that can be extended to other programs or institutions, paving the way for comparative research and the harmonization of admissions practices.

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