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Integration of databases and synthetic data in school management: an approach to support decision-making.

Integration of Databases and Synthetic Data in School Management: An Approach to Decision-Making Support

Integration of databases and synthetic data into school management: an approach to support decision making

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ABSTRACT: The increasing digitalization of educational institutions has significantly expanded the production and storage of academic and administrative information, making it necessary to use computer systems capable of organizing and analyzing this data efficiently. In this context, this study aimed to analyze how the modeling of computer systems, integrating relational databases and synthetic data, can contribute to supporting decision-making in school management.

Methodologically, the research is characterized as applied, with a qualitative approach and exploratory and descriptive objectives, developed through bibliographic review and...

This study proposes a three-tiered computational architecture. The proposed structure includes a relational database in SQL, mechanisms for validating academic information, the use of synthetic data for scenario simulation, and dashboards for visualizing institutional indicators. The results indicated that the integration of these technologies favors...

The organization of data, the automation of administrative processes, the generation of educational indicators, and greater analytical support for school administrators are key advantages. Furthermore, the use of synthetic data has demonstrated potential for conducting tests and analyses without compromising the privacy of institutional information. In conclusion, the proposed approach has the potential to strengthen data-driven school management practices, promoting greater efficiency, information security, and strategic support for decision-making.

Keywords: School management; Database; Synthetic data; Decision making; Educational dashboards.

ABSTRACT: The increasing digitalization of educational institutions has significantly expanded the generation and storage of academic and administrative information, necessitating computational systems capable of efficiently organizing and analyzing data. In this context, the study aimed to analyze how computational modeling systems that integrate relational databases and synthetic data can contribute to decision support in school management. Methodologically, the research is characterized as applied, with a qualitative approach and exploratory and descriptive objectives, developed through a literature review and the proposal of a three-layer computational architecture. The proposed structure includes a relational SQL database, academic information validation mechanisms, synthetic data for scenario simulation, and dashboards for visualizing institutional indicators. The results indicated that integrating these technologies improves data organization, the automation of administrative processes, the generation of educational indicators, and analytical support for school managers. Furthermore, the use of synthetic data demonstrated its potential to conduct tests and analyzes without compromising the privacy of institutional information. It is concluded that the proposed approach has the potential to strengthen data-driven school management practices, promoting greater efficiency, information security, and strategic support for decision-making.

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Keywords: School management; Databases; Synthetic data; Decision-making; Educational dashboards.

1. INTRODUCTION

The increasing digitalization of organizational processes has led to transformations. significant in the way data is collected, stored, and used to support strategic processes in different areas of society (Kitchin, 2014). In the context In education, this transformation has become even more relevant given the increase in production. academic, administrative and pedagogical information generated daily by educational institutions. According to the OECD (2023), the use of digital technologies in education It has been expanding institutional monitoring capacity and promoting management practices. evidence-based.

In this scenario, educational data has come to play a strategic role in educational institutions, enabling analyses related to academic performance, school attendance, dropout rates, class performance and administrative indicators (INEP, 2023). According to Garcia (2020), contemporary school management requires mechanisms capable of Transforming large volumes of data into useful information for institutional planning. and support for decision-making. However, many institutions still face difficulties. related to data fragmentation, lack of integration between systems, and limitations in interpretation of available information (Lima; Santos, 2021).

Manually analyzing this information also presents a significant challenge in educational environment. According to Cardoso (2018), administrative processes carried out without Computational support tends to demand more operational time, in addition to presenting greater... susceptibility to errors, inconsistencies in registration data, and loss of relevant information. In this way, the use of computer systems becomes essential for process automation. and for the structured organization of institutional data.

In this context, computer engineering plays a fundamental role in development of technological solutions capable of integrating, storing and processing information in an efficient way. Sommerville (2019) highlights that well-functioning computer systems Structured solutions promote reliability, scalability, and operational efficiency. especially in environments that demand the continuous processing of large volumes of data. Furthermore, Pressman (2016) states that computational architectures organized in

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Multiple layers contribute to improved maintenance, modularity, and...
application performance.

Among the main technologies used in these systems are relational databases.
They stand out for their ability to organize information in a structured way and to guarantee the
Referential integrity between stored records. According to Elmasri and Navathe (2019), the
Database management systems are fundamental to ensuring consistency,
security and accessibility of information, especially in environments that depend on
multiple relationships between data, such as in educational institutions.

However, the use of real data in educational computing applications presents...
Limitations regarding the privacy and protection of students' personal information. Data
Academics, school attendance, performance, and institutional records are sensitive data.
and require rigorous information security mechanisms (Brazil, 2024). In this context, the
Synthetic data emerges as a strategic alternative for the development and validation of
computer systems, without direct exposure to real-world information.

According to Goodfellow, Bengio, and Courville (2016), synthetic data consist of
sets of information artificially generated by computational models capable of
reproduce statistical patterns similar to those observed in real data. This data
They enable simulations, computational tests, and analytical validations without compromising the...
user privacy. Furthermore, Russell and Norvig (2021) highlight the use of data
artificial intelligence significantly expands the capacity for developing analytical models and
intelligent systems focused on forecasting and decision support.

The integration between databases, synthetic data, and computer systems.
It enables the construction of technological environments capable of transforming data into support.
strategic to school management. According to Davenport and Harris (2007), organizations oriented by
Data provides greater capacity for planning, monitoring, and adapting to demands.
institutional. In the educational environment, this approach contributes to strengthening
evidence-based management, reducing subjectivity in decision-making processes, and improvement.
of administrative efficiency.

Given this context, this study aims to analyze how modeling and...
Implementation of computer systems, integrating relational databases and data.
Synthetic technologies can contribute to process optimization and support decision-making.
in school management. The research seeks to highlight the role of computer engineering in

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building technological solutions applied to education, highlighting their contributions to
The organization, analysis, and strategic use of institutional information.

2. THEORETICAL FRAMEWORK

2.1 Data-Driven School Management

The increasing digitalization of educational processes has brought about changes.
significant in the way educational institutions organize, store and use
academic and administrative information. The advancement of digital technologies has expanded
considerably the production of data related to school performance, attendance, and
dropout, evaluations and institutional indicators, making the use of
mechanisms capable of transforming this information into strategic support for decision-making.
decision (Kitchin, 2014). According to Garcia (2020), contemporary school management increasingly demands
more decisions based on concrete evidence, reducing practices that are exclusively based on evidence.
intuitive and strengthening data-driven approaches.

In this context, educational data has come to play a strategic role.
in educational institutions, since they allow for continuous performance monitoring.
academic and more detailed monitoring of institutional demands (INEP, 2023).
Libâneo (2018) states that the structured use of educational indicators contributes
directly to the improvement of pedagogical and administrative planning, allowing that
Managers identify difficulties, monitor results, and develop more effective strategies.
efficient. In this way, data-driven management ceases to be just a function.
It becomes operational and integrates into the strategic processes of educational institutions.

Despite the growth of computerization in schools, many institutions still face challenges.
difficulties in integrating and interpreting available information. Lima and Santos (2021)
They highlight that educational data is often fragmented across different
decentralized systems, spreadsheets, or records, which makes broader analyses difficult and
This undermines the reliability of institutional indicators. Furthermore, the absence of
Integration between the administrative and pedagogical sectors significantly reduces capacity.
The analytical framework of schools limits the development of evidence-based strategies.

Manual analysis of information also represents a significant challenge in this context.
educational. According to Cardoso (2018), administrative processes carried out without support

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Computational processes require more operational time and are more susceptible to failures.
Humans, registration inconsistencies, and the loss of relevant information. In this scenario, the
Computer systems become fundamental tools for task automation and...
Organization of institutional data, allowing for greater operational efficiency and reduction of costs.
Errors related to the manual processing of information.

Another important aspect relates to the need for contextualization of the indicators.
educational. Mendes and Costa (2023) state that data analyzed in isolation can generate
limited or mistaken interpretations, making it necessary to consider factors related to
socioeconomic profile of students, institutional structure and pedagogical context of
school. Integrating these variables into computer systems facilitates more comprehensive analyses.
complete and consistent, allowing for interpretations that more closely reflect educational reality and
strengthening the decision-making process.

Furthermore, the use of technologies focused on data analysis contributes to...
Consolidation of an evidence-driven organizational culture. Davenport and Harris (2007)
They highlight that institutions that use data as a strategic support show greater
capacity for planning, monitoring, and adapting to institutional changes.
In a school setting, this approach promotes greater administrative transparency.
Continuous monitoring of institutional performance and reduction of subjectivity in
decision-making processes.

The integration between computer systems and school management also enables greater
speed in accessing institutional information. According to the OECD (2023), the strategic use of
Digital technologies enable the automated generation of reports and real-time monitoring.
Real indicators and the significant improvement in the administrative efficiency of institutions.
educational institutions. Therefore, the digital transformation of education increasingly demands more...
Tools capable of organizing large volumes of data in a structured and accessible way.
to managers.

In addition to administrative benefits, data-driven management also generates
significant impacts on pedagogical monitoring. Borges and Silva (2019) state that the
Continuous analysis of academic indicators facilitates the early identification of difficulties.
learning and enables the development of more efficient pedagogical interventions.
Thus, the strategic use of data contributes not only to administrative optimization,
but also to improve the quality of education offered by educational institutions.

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In this way, it can be observed that data-driven school management constitutes a A fundamental approach to modernizing contemporary educational institutions. Garcia (2020) highlights the integrated use of analytical technologies and systems Computational tools significantly strengthen decision-making processes and increase efficiency. administrative and contributes to building more organized educational environments, strategic and evidence-based.

2.2 Database Systems Applied to Education

Database systems play an essential role in the organization and in Information management in educational environments. The increasing volume of data. The data produced by educational institutions requires structures capable of storing, processing, and to make information available in an efficient, secure and organized manner (Elmasri; Navathe, (2019). According to Geppart and Kotz (2019), databases represent mechanisms fundamental for the control and management of large volumes of information, allowing greater reliability and accessibility to stored records.

In the educational context, databases are used for management of enrollments, grades, school attendance, academic history, administrative data and indicators institutional. Costa and Oliveira (2022) state that the centralization of this information in Integrated systems reduce registration redundancies and significantly improve efficiency. operational efficiency of educational institutions. Furthermore, the use of organized structures is beneficial. Faster queries and more accurate analysis of educational data.

Database modeling is a fundamental step in the development of computer systems geared towards school management. Pressman (2016) highlights that the modeling allows you to define entities, relationships, and integrity rules that represent appropriately reflect the institutional reality within the computing environment. In this way, a A well-modeled data structure reduces informational inconsistencies and increases reliability. reliability of subsequent analyses.

Among the available models, relational databases stand out for... The ability to organize structured information into interrelated tables. According to According to Elmasri and Navathe (2019), the relational model presents a high level of integrity. referentiality and consistency of data, essential characteristics in environments that demand Strict control of stored information. In an educational context, data such as grades,

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Frequency, classes, and subjects exhibit strong structural dependence, which requires Organized and consistent relationships between records.

Furthermore, the SQL language allows for the execution of complex queries and the Efficient cross-referencing of academic information. Elmasri and Navathe (2019) state that SQL It is one of the main tools for manipulating relational databases, allowing The generation of analytical reports, the monitoring of indicators, and structured recovery. institutional information. In this way, the use of SQL significantly expands the analytical capacity of computer systems geared towards educational management.

Although relational databases are widely used, new approaches, such as NoSQL databases have also been gaining ground in contemporary computing applications. Chen, Mao, and Liu (2014) highlight that NoSQL systems offer related advantages. due to structural flexibility, scalability, and distributed processing of large volumes. of unstructured data. These characteristics make this model suitable for applications which require high computational elasticity and the handling of heterogeneous data.

However, in the context of school management, the relational model presents greater [symbolism/preference]. Suitability due to the need for referential integrity, standardization, and transactional control. from academic information. Elmasri and Navathe (2019) state that relational databases They offer greater structural security in scenarios where different records depend on each other. directly from one another, as occurs in academic systems. In this way, the use of SQL This makes it more suitable for ensuring the consistency and reliability of educational data.

Another important aspect relates to information security in the systems. educational institutions. Zuboff (2019) highlights that institutions that store personal data need adopt rigorous access control and information protection mechanisms, especially In increasingly connected digital environments, database systems are crucial. They must incorporate encryption, authentication, and access monitoring features to to guarantee the security and privacy of institutional information.

In addition to security, the scalability of systems is also a relevant factor for... contemporary educational institutions. Sommerville (2019) states that systems Computational systems need to be developed considering the continuous growth in volume of data and the simultaneous increase in the number of users accessing institutional information. In this way, well-structured architectures contribute to greater operational stability and improved performance of school management systems.

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Therefore, database systems are central elements in the construction of technological solutions geared toward education. Cardoso (2018) highlights the use of structures Organized data storage and analysis promotes greater administrative efficiency. greater informational reliability and strategic support for decision-making in institutions teaching.

2.3 Synthetic Data and Privacy

The use of synthetic data has become established as a relevant alternative for resolving issues related to privacy, security, and availability of Information in computing environments. The growth of digitization has expanded The collection and storage of personal data significantly increases, making it indispensable to developing strategies capable of enabling analyses and tests without compromising the sensitive user information (Zuboff, 2019). In the educational context, this need This becomes even more evident due to the large volume of academic and administrative data. that educational institutions manipulate daily.

According to Goodfellow, Bengio, and Courville (2016), synthetic data consist of sets of information artificially generated by computational models capable of reproduce statistical characteristics similar to those observed in real data. Although not While these data represent authentic records of specific individuals, they maintain consistent patterns. Distributions and behaviors close to reality, allowing for simulations and analyses. computational methods without direct exposure of the original information.

The use of real data in educational systems presents several limitations. related to privacy and protection of personal data. Information related to academic performance, school attendance, disciplinary record, and records Administrative matters are sensitive and require rigorous security mechanisms. confidentiality (Brazil, 2024). In this scenario, synthetic data emerges as an alternative. strategic for the development and validation of computer systems, without compromising the integrity of institutional information.

Furthermore, the use of synthetic data facilitates large-scale testing. scale and the simulation of varied scenarios in computer systems. Alpaydin (2021) highlights That environments based on artificial intelligence allow for the evaluation of algorithm performance. Test functionalities and validate applications without the risks associated with exposing real data.

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In this way, synthetic data significantly expands the possibilities of
Technological experimentation in educational contexts.

Another important aspect relates to the contribution of synthetic data to the
Training artificial intelligence and machine learning models. Mitchell (1997)
states that computer systems depend on large volumes of information to
to build more accurate and efficient analytical models. However, in many cases, the
The availability of real data is limited due to legal or operational restrictions, which makes
Synthetic data is a relevant solution for expanding computational training databases.

The generation of synthetic data can occur through different computational methods.
including statistical modeling, probability sampling, and intelligence-based techniques
artificial. Goodfellow, Pouget-Abadie and Mirza (2014) highlight that generative models, such as
Generative adversarial networks allow the creation of datasets capable of reproducing...
Complex patterns observed in real databases. These approaches raise the level of
The realism of artificially generated information strengthens the quality of analyses.
subsequent.

However, the efficiency of synthetic data depends directly on the quality of the...
models used in its generation. Hernández-Orallo (2020) states that artificial data poorly
Calibrated methods can introduce statistical distortions and compromise the validity of the analyses.
computational. Therefore, it becomes essential to develop validation processes.
capable of comparing real and synthetic data, ensuring consistency between distributions and patterns.
and behaviors observed in the information sets.

In addition to protecting personal data, synthetic data also facilitates construction.
of hypothetical scenarios and the performance of predictive analyses. Russell and Norvig (2021) highlight
Computer simulation allows for the prior assessment of the impacts of certain...
strategies before their practical implementation, reducing operational risks and expanding the
The analytical capacity of systems. In an educational context, this functionality enables
Projections regarding school dropout rates, academic performance, and student attendance.

Another relevant benefit relates to the legal compliance of computer applications.
Silva and Freitas (2024) state that the use of synthetic data reduces the risks associated with
non-compliance with data protection laws, especially in environments that
They handle sensitive personal information. In this way, educational institutions
They are able to expand the analytical use of information without compromising the requirements of
Privacy and information security.

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Therefore, synthetic data constitutes a strategic tool for the
Development of computer systems for school management. Goodfellow, Bengio and
Courville (2016) highlight the ability to reproduce statistical patterns without exposure.
The availability of personal information significantly expands the analytical potential of applications.
contemporary technologies. Thus, the integration between synthetic data, privacy, and analysis.
Computational technology contributes directly to building safer educational environments.
efficient and data-driven.

2.4 COMPUTATIONAL SYSTEMS AND DECISION SUPPORT

Computer systems designed to support decision-making have as their main objective
to assist managers in analyzing information and choosing the most appropriate alternatives for the
Resolution of institutional problems. The growth in the volume of organizational data.
traditional manual analysis methods became insufficient, requiring the development of
tools capable of processing information quickly, in a structured and efficient manner (Turban)
et al., 2015). In this context, decision support systems have come to play a role.
Strategic in different sectors, including the educational environment.

According to Turban et al. (2015), decision support systems consist of tools
computational tools that integrate data, analytical models, and interactive interfaces to assist
decision-making processes related to structured and semi-structured problems. These applications
They allow you to transform large volumes of information into strategic knowledge.
expanding the analytical capacity of organizations and reducing the associated levels of uncertainty.
to institutional decisions.

In the educational context, computer systems have been used for the
monitoring academic performance, attendance tracking, analysis of
School dropout and the generation of administrative indicators. Nascimento and Barbosa (2022)
They claim that the use of analytical technologies in education contributes significantly to
Improving institutional planning allows for faster identification of difficulties.
pedagogical and

operational. In this way, decision support systems become tools.
fundamental for the modernization of school management.

The architecture of these systems is generally composed of different layers.
Responsible for storing, processing, and displaying information. Pressman

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(2016) highlights that structured architectures favor modularity, scalability and maintenance of computer systems, which allows for greater operational efficiency and adaptation to institutional demands. In this sense, the separation between the interface, the logic of The application and data layer contribute to better organization of workflows. informational.

In addition to the computational structure, data analysis algorithms constitute fundamental components of decision support systems. Han, Kamber and Pei (2011) state Data mining techniques allow us to identify patterns, trends, and correlations. relevant in large volumes of data. These analyses significantly expand the The predictive capacity of systems favors more strategic decisions in institutions. educational.

Another important element relates to the use of machine learning techniques in analysis of educational data. Russell and Norvig (2021) highlight that computational models Intelligent systems enable the development of predictive analyses of behavior. users and the identification of complex patterns in institutional data. In the school environment, These technologies can contribute to predicting dropout rates and monitoring performance. academic performance and the identification of factors associated with student achievement.

The visualization of information also plays an essential role in the systems. decision support. Costa and Oliveira (2022) state that interactive dashboards and reports They facilitate the interpretation of institutional indicators, allowing managers to understand Quickly assess the organization's situation and develop more efficient strategies. In this way, The graphical visualization of information reduces analytical difficulties and strengthens processes. decision-making based on evidence.

Furthermore, the integration between real and synthetic data significantly expands the analytical capabilities of these systems. Goodfellow, Bengio, and Courville (2016) highlight that Artificial data enables the simulation of scenarios and the performance of tests without compromising performance. sensitive information. In an educational context, this functionality allows... development of projections related to school performance, dropout rates, and Academic behavior, without direct exposure of students' real data.

However, the efficiency of computer-based decision support systems depends directly from the quality of the information used in analytical processing. Manyika et al. (2011) state that inconsistent, incomplete, or poorly structured data compromise This significantly improves the reliability of analyses performed by computer systems.

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In this way, it becomes essential to ensure integrity, standardization, and continuous updating.
of the information databases used by technological applications.

Therefore, computer-based decision support systems represent tools
strategies for modernizing contemporary school management. Sommerville (2019) highlights
the integration between analytical technologies, databases, and computational intelligence
It significantly expands institutional planning capacity and strengthens processes.
evidence-based decision-making. Thus, the use of these tools directly contributes
for the construction of more efficient, organized, and guided educational environments.
data analysis.

3. METHODOLOGY

This research was developed using a qualitative approach and an applied character.
with the aim of proposing a computational structure focused on supporting decision-making.
in school management through the integration of relational databases, synthetic data and
analytical systems. The methodology adopted focused on the logical modeling of
system, in the structural organization of the database and in the definition of the computational flow
Responsible for processing and analyzing academic and administrative information.

Initially, the logical structure of the computer system was defined, considering the
main demands in the context of school management. To this end, the entities were identified.
fundamentals of the educational environment, including students, classes, subjects, grades, attendance.
and teachers. Based on these entities, the database model was developed.
using the entity-relationship model (ERM), allowing for structured representation
of the information and the definition of the relationships that exist between academic records.
According to Elmasri and Navathe (2019), entity-relationship modeling constitutes one of the
key steps in the development of relational databases, as it enables...
Logical organization of information and reduction of structural inconsistencies.

The developed model sought to ensure referential integrity and standardization.
institutional data, essential factors for the reliability of subsequent analyses performed
by the system. In this context, primary and foreign keys responsible were established.
through the relationship between tables and the control of stored academic information.
This relational structure allows for better organization of records and facilitates the completion of...

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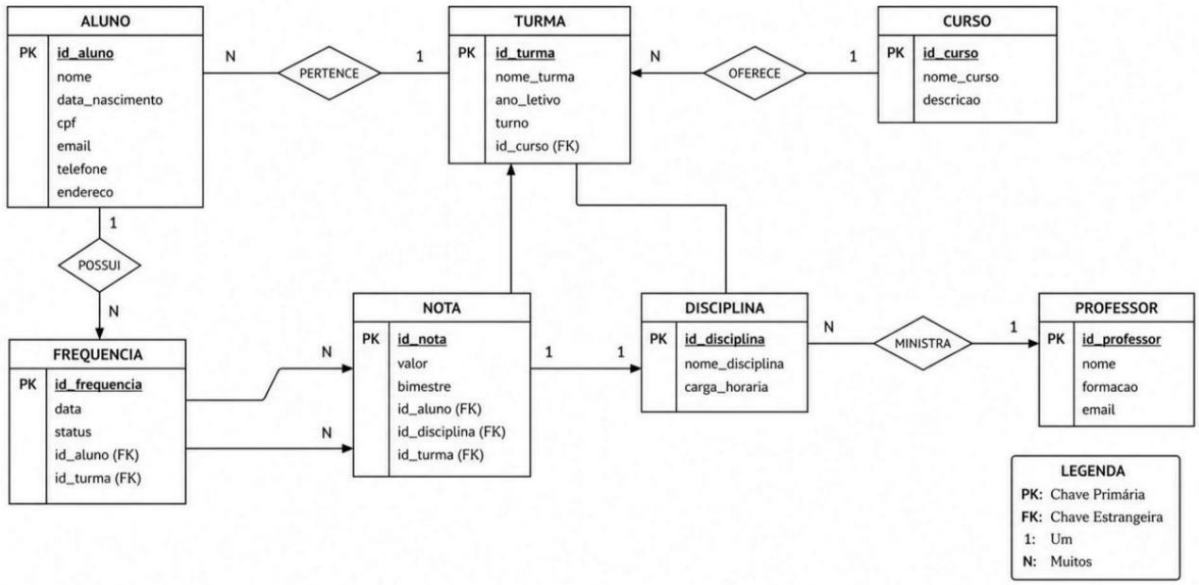
more complex analytical queries, fundamental for generating educational indicators.
and to support decision-making.

Figure 1 presents the entity-relationship model developed to represent
Logically, the database proposed in this study. The diagram presents the main...
entities of the system, as well as the relationships responsible for the integration of the
Academic and administrative information.

Figure 1 — Entity-relationship model (ERM) of the system



Source: Prepared by the author (2026)

Another important aspect of the methodology relates to the choice of database.
A relational database based on SQL for storing system information. The use of
SQL was defined due to the need for referential integrity, structural standardization, and...
Consistent relationship between academic data. Information such as attendance, grades,
Subjects and academic records are highly interdependent, which requires mechanisms.
capable of ensuring the consistency of records and the reliability of queries. According to
Elmasri and Navathe (2019) argue that relational databases demonstrate greater efficiency in environments that
They require structured control of information and the execution of complex queries.
involving multiple relationships.

Although NoSQL technologies offer advantages in scalability and flexibility.
Structurally, its application proved less suitable for the central objectives of this research.
NoSQL systems are best suited for environments with unstructured data and

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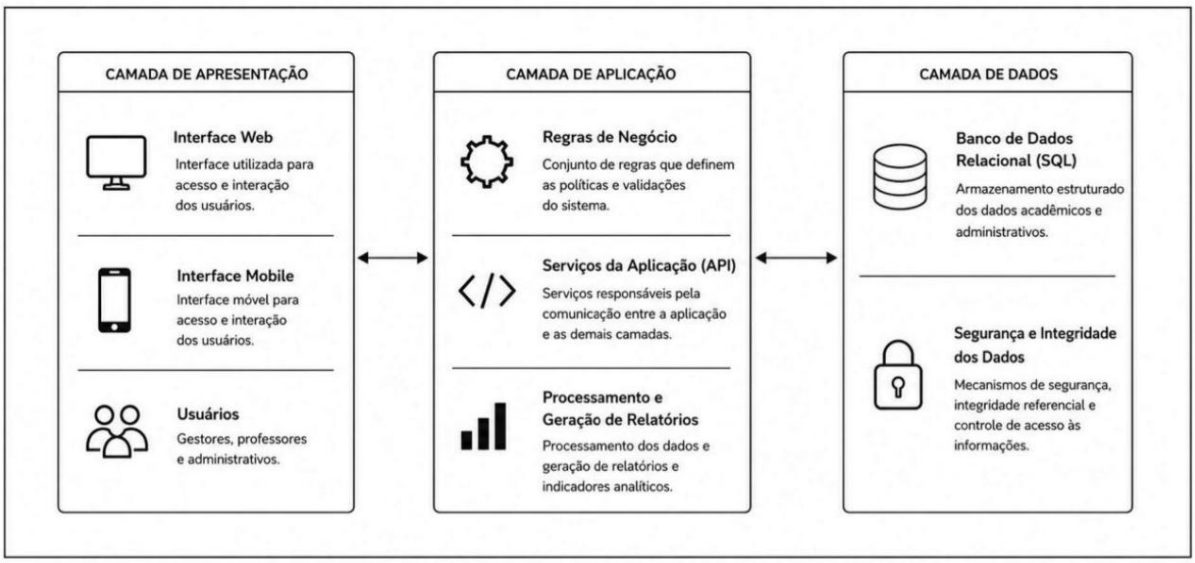
Large-scale distributed processing, while educational systems require greater
Relational control, record integrity, and standardization of academic information. Therefore...
In this way, the use of SQL proved to be more appropriate for ensuring structural stability and security.
of information and analytical reliability in the context of school management.

In addition to database modeling, the research also included defining the
computational architecture of the system. The proposed structure was organized into three layers.
main layers: presentation, application, and data. The presentation layer corresponds to...
The interface responsible for interaction with system users, allowing insertion and querying.
and visualization of institutional information. The application layer concentrates the rules of
business, information processing and the execution of analytical functionalities of
The system. The data layer, on the other hand, is responsible for storing, in a structured way, the
academic information in an SQL relational database. According to Sommerville (2019),
Multi-layered architectures promote modularity, maintainability, and scalability.
of computer systems, allowing for greater operational efficiency and better organization of
information flows.

Figure 2 presents the computational architecture developed for the proposed system.
The diagram demonstrates the communication between the application layers and the flow responsible for...
processing and analysis of academic information.

Figure 2 — System architecture



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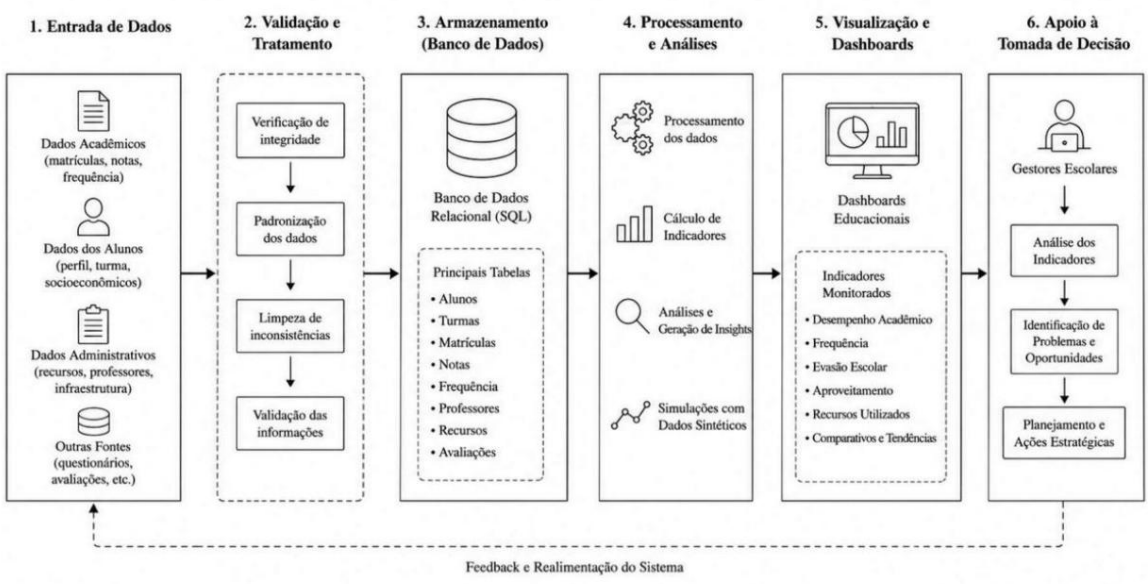
The methodology also involved defining the logical workflow of computer system. Initially, academic and administrative data are entered by Users receive the information through the application interface. Then, the information goes through various processes. Validation processes that verify the consistency of records and prevent duplicates and inconsistencies. registration data. After validation, the data is stored in a relational SQL database. which allows for subsequent analytical processing and the generation of educational indicators.

Subsequently, the system performs queries and cross-references the stored information. enabling the automatic generation of reports, dashboards, and indicators used in support. to decision-making. This computational flow enables process automation. administrative processes and the reduction of time required to analyze institutional information. According to Turban et al. (2015), data analysis-oriented computer systems expand significantly improves the ability to interpret organizational information and strengthens evidence-based decision-making processes.

Figure 3 presents the flowchart of the system developed in research. The diagram illustrates the steps of input, validation, storage, processing and Visualization of institutional information.

Figure 3 — Flowchart of the proposed school management system



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Another element incorporated into the methodology was the use of synthetic data to simulate and to validate the computational system. Synthetic data were used as an alternative to Reproduction of academic scenarios, without exposing real user information. According to Goodfellow, Bengio and Courville (2016) argue that synthetic data allow for the preservation of statistical patterns. relevant without compromising the privacy of individuals, favoring development and Testing of computer applications in compliance with data protection requirements.

The generation of synthetic data took into account variables related to the context. educational, including school attendance, academic performance, class averages and indices of evasion. This data was used for consultation simulations, generation of indicators and Structural validation of the proposed system. The use of this artificial information allowed for... conducting computational tests without compromising the security and confidentiality of the academic records.

In addition, dashboard models were developed to visually represent the Indicators generated by the system. The dashboards simulate decision support features capable to present information about institutional performance, school attendance, and rates of dropout and academic performance. According to Few (2013), the graphical visualization of information It facilitates faster interpretation of organizational data and enhances analytical capabilities. of the managers.

In this way, the methodology adopted made it possible to structure a computational proposal. integrated, based on relational modeling, multi-layered architecture, data analysis and in The use of synthetic data to support evidence-based school management.

4. RESULTS AND DISCUSSION

The results of the system modeling demonstrated that the integration between banks of Relational data, synthetic data, and computational systems can contribute significantly for the modernization of school management. The developed proposal highlighted that the centralization of academic and administrative information promotes greater institutional organization, reducing problems related to data fragmentation, to Inconsistencies in registration data and difficulty accessing information. In school environments in Given that different sectors use independent records, the lack of integration often... It undermines the reliability of institutional indicators and makes monitoring more difficult. pedagogical and administrative demands.

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The implemented relational structure proved to be better suited to the context. educational due to the need for logical organization between entities such as students, subjects, classes, attendance, and assessments. During the system modeling, it was observed that The use of a relational database enabled greater control over referential integrity and greater consistency among academic records. This feature proved essential for to avoid duplications, inconsistencies, and errors frequently found in controls. performed manually or in a decentralized manner.

Furthermore, it was found that the use of the SQL language significantly expanded the The analytical capacity of the proposed system. The possibility of performing structured queries and the The cross-referencing of information allowed for the automated generation of indicators related to academic performance, school attendance, and dropout rates. This process reduces the time required to obtain institutional information and promotes greater agility in Preparation of reports used by school administrators in the decision-making process.

Although NoSQL databases offer advantages in flexibility and scalability, The results indicated that its use would not be the most suitable alternative for the objectives. The central elements of this research are educational systems, which depend directly on relationships. structured and consistent transactional information across academic records, which requires Strict mechanisms for the integrity of tables and associated information. In this context, The relational model proved to be more efficient in ensuring structural stability. Information security and the reliability of the analyses performed by the system.

Another relevant result relates to the three-tiered computational architecture. used in the development of the proposal. The separation between the presentation layers, of The application and data management fostered a better structural organization of the system, allowing for greater Modularity and greater ease of maintenance. This division also contributes to future Application expansions, enabling the integration of new features without compromising functionality. the overall functioning of the system. In institutional environments, this characteristic becomes important due to the continuous need for technological updating and adaptation to organizational demands

The results also demonstrated that the use of synthetic data represents a an efficient alternative for conducting computational tests, simulations, and validations, without exposing sensitive user information. The artificial generation of data made it possible to reproduce scenarios close to academic reality, maintaining statistical standards similar to observed in real educational environments. In this way, it was possible to carry out analyses on

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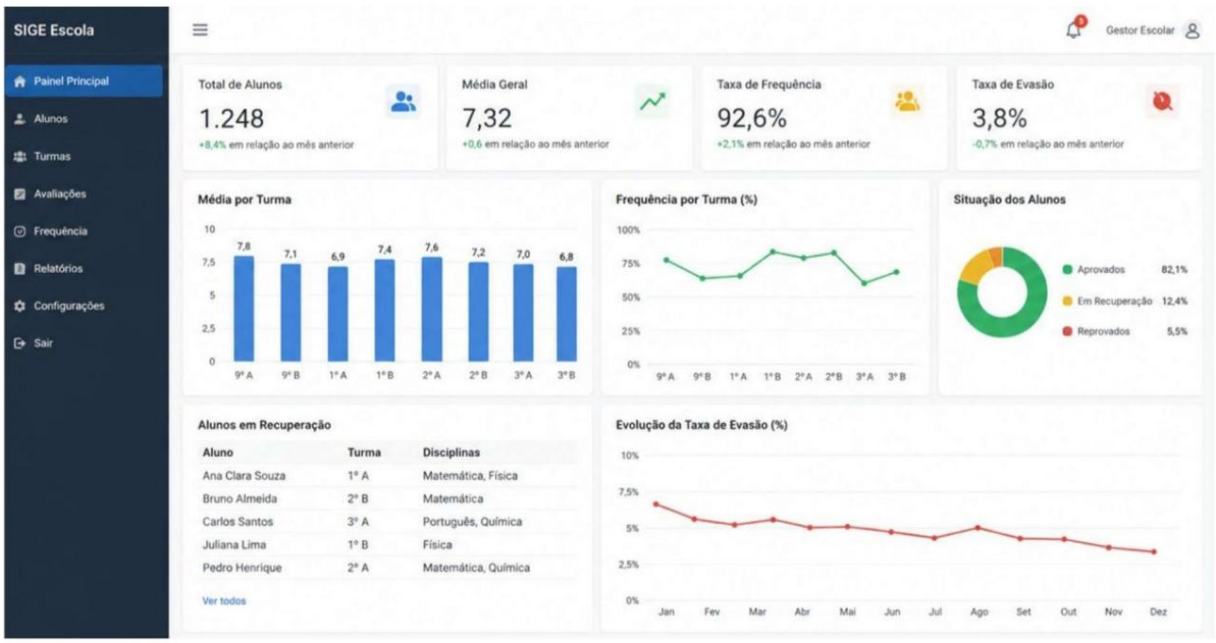
student performance, school attendance, and dropout rates, without compromising privacy.
institutional.

To demonstrate the applicability of the proposed solution, a prototype was created.
functional, based on the computational architecture presented in the methodology. Figure 4
presents the educational indicators panel generated from the integration between a database of
relational data, synthetic data, and an analytical system, which allows for visualization.
organized metrics related to academic performance, school attendance, and
dropout rates.

Figure 4 — Educational indicators dashboard generated by the prototype



Source: Prepared by the author (2026)

The use of synthetic data has also shown potential to expand capacity.
predictive system. The simulation of different academic scenarios allowed us to observe how
Changes in certain indicators could impact institutional performance. This
This aspect strengthens the strategic use of data in school management, as it enables analysis.
preventive measures and the development of actions more targeted to the institution's needs.
Thus, administrators can anticipate potential academic difficulties and develop interventions.
more effective solutions before problems cause more significant impacts on the school environment.

Another relevant point identified in the results was the contribution of dashboards to
The interpretation of institutional information. The graphical visualization of the indicators made the

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Faster, more intuitive, and more accessible data tracking for school administrators. Instead of By relying exclusively on extensive spreadsheets or manual analysis, users are able to to identify patterns, performance variations, and potential institutional problems in a way more objective. This reduces interpretative difficulties and strengthens decision-making processes. based on concrete evidence.

Furthermore, the simulated dashboards allowed for an integrated visual representation of educational indicators, facilitating the simultaneous analysis of different institutional variables. Information related to attendance, academic performance, class averages, and indexes of The escape routes could be organized into a single visual environment, which promoted greater clarity. analytical. This integration contributes to the optimization of the management process, as it reduces the time. expenses incurred in searching for information scattered across different administrative records.

The results also showed that automating the indicators reduces significantly reduce operational failures associated with manual processes. In many In institutions, academic reports still rely on the manual organization of spreadsheets and... Decentralized records increase the risk of inconsistencies and delays in analysis. institutional. With the automation proposed by the system, the data will be processed in a continuous and organized manner, which promotes greater accuracy in the generation of indicators. educational.

Another important aspect observed refers to the system's potential for Strengthening a data-driven organizational culture. The constant availability of Academic indicators promote more informed decisions and reduce dependence on... exclusively subjective interpretations on the part of school management. Therefore, the use The use of structured data contributes to the development of more efficient institutional strategies and aligned with the needs identified in the educational environment.

The proposal also demonstrated potential for improving communication between sectors. administrative and pedagogical. Centralizing information in a single system reduces... difficulties in data sharing between departments and favors a greater Institutional integration. This allows different sectors to have access to the same resources. Updated information, reducing registration discrepancies and increasing efficiency. operational aspects of the institution.

In addition to administrative benefits, the results indicated significant impacts on Academic monitoring of students. Continuous analysis of indicators allows to identify changes in academic performance and school attendance more quickly,

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allowing for earlier interventions by the teaching staff. In this way, the
The system contributes not only to administrative organization, but also to improvement.
educational monitoring and support for student performance.

The results also highlighted positive impacts on safety and reliability.
of institutional information. The use of relational structures associated with the mechanisms
Data validation reduced the risks of registration inconsistencies and data loss.
relevant. Furthermore, the use of synthetic data minimizes the risks associated with
Exposure of sensitive personal data, an increasingly important aspect in light of the demands
contemporary data protection and privacy practices.

Another relevant factor observed during the analysis was the possibility of future expansion.
of the system. The modular structure of the architecture allows integration with new technologies and
analytical tools, including artificial intelligence systems, data mining and
more advanced predictive models. This flexibility expands the potential for evolution of
This application facilitates adaptation to the future technological demands of the educational environment.

However, some limitations were also identified during development.
of the proposal. The lack of practical implementation of the system prevents a more thorough evaluation.
in-depth analysis of the application's operational performance, usability, and behavior in
real institutional environments. Although the modeling demonstrates structural coherence and
Regarding conceptual feasibility, it has not yet been possible to empirically measure factors related to
computational performance and user experience in the effective use of the system.

Furthermore, the efficiency of the analyses depends directly on the quality of the data.
synthetics used in the simulations. If the statistical patterns generated do not represent
While not adequately reflecting institutional reality, distortions can occur that may compromise the...
interpretations and predictions of the system. Therefore, it becomes essential to develop
Rigorous validation mechanisms to ensure greater fidelity between artificial data and the original data.
Real-life scenarios depicted.

Another limiting factor relates to the need for adequate technological infrastructure.
for the full implementation of the proposal in educational institutions. Issues related to
server availability, integration with existing systems, connectivity and
The technical training of users can directly influence the operational efficiency of
application. In institutions with less technological infrastructure, these factors may represent
additional challenges to the practical implementation of the proposed system.

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Even with these limitations, the results demonstrated that the integration between Relational databases, synthetic data, and decision support systems have increased potential to strengthen data-driven school management practices. The proposal It has become clear that computer engineering can contribute directly to... developing solutions capable of transforming academic information into support strategic to institutional planning, promoting greater administrative efficiency, Information security and analytical quality in educational decision-making processes.

FINAL CONSIDERATIONS

The aim of this research was to analyze how modeling and Implementation of computer systems, using synthetic data and databases. They can contribute to process optimization and support decision-making in management. school. From the analysis carried out, it was possible to understand that the integration of these Technologies have significant potential to improve the organization, processing, and Interpretation of educational information.

The results demonstrated that the use of relational databases provides greater control over the integrity and consistency of academic information, an essential factor in educational environments. The choice of the relational model proved to be appropriate due to The need for structured relationships between students, classes, assessments, and indicators. as well as the possibility of performing complex analytical queries through the language. SQL.

Similarly, it was found that synthetic data constitute an alternative. A strategic approach to expanding analyses and simulations without compromising user privacy. Using this resource allows you to develop tests, validate systems, and create predictive scenarios. without exposing sensitive information, while meeting security and data protection requirements.

Another relevant aspect identified was the contribution of the three-layer architecture. for the efficiency and scalability of the system. The separation between interface, processing and Storage facilitates the maintenance, updating, and expansion of the application, making it... a proposal that is more adaptable to the needs of educational institutions and provides greater operational stability.

Beyond the technical aspects, the study showed that data-driven systems They can strengthen evidence-based management practices. The automation of indicators and

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The use of dashboards makes the decision-making process faster, more organized, and more efficient.
strategic, reducing operational errors and increasing the analytical capacity of managers.
schoolchildren.

The research also demonstrated that computer engineering plays a role.
relevant in modernizing education, especially by integrating technologies capable of
Transforming large volumes of data into information useful for institutional planning.
In this way, the study contributes by presenting a proposal aligned with the demands.
Contemporary digital transformation trends in education.

However, the research has limitations due to the lack of implementation.
The system's practical application. The proposal was validated only at a conceptual level, which makes it impossible to put into practice.
to measure actual performance, usability, and operational impact in educational environments
concrete.

As future work, the development of a functional prototype is recommended.
integrated with real data visualization and analysis tools, as well as conducting tests.
in educational institutions for practical validation of the proposed solution. It is also suggested
To deepen studies on artificial intelligence, data mining, and predictive models.
applied to school management.

Finally, it can be concluded that the integration between relational databases and synthetic data...
Decision support systems represent a promising approach to educational management.
contemporary. The proposal presented demonstrates potential to promote greater efficiency,
security and analytical quality, strengthening more strategic decision-making processes and
based on data.

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