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Implementation of Role-Based Access Control Method in Web-Based School Administration Payment Information System

ABSTRACT

The administration of school payments is a vital component of financial management that requires security, precision, efficiency, and transparency. Nonetheless, numerous current systems exhibit deficiencies in user access management, which may result in data breaches and the misuse of information. This study examines these concerns at a school in Bandung by employing the Role-Based Access Control (RBAC) methodology within a web-based school administration payment system. The research employs a prototype methodology encompassing phases of requirements analysis, system design, prototyping, assessment, refinement, and implementation. The system implements Role-Based Access Control (RBAC) to limit access privileges according to designated roles: administrator, treasurer, headmaster, and parents. As a result, each user accesses only the data and functionality pertinent to their duties. The research findings indicate that RBAC improves data security, minimizes potential errors, and streamlines access rights management. The implemented system facilitates effective payment documentation, transaction validation, student information administration, and financial reporting. This system ultimately establishes a more organized and regulated administrative process, enhancing the quality of educational services.

Keywords: Information System, School Payments, RBAC, Prototype, Educational Administration.

INTRODUCTION

The administration of school payments is a crucial aspect of financial management that necessitates secure, accurate, swift, efficient, and transparent execution, particularly as data and transaction volumes increase. Nonetheless, user access control challenges frequently hinder the administration of these systems. Numerous systems currently lack sufficient access controls (Gugun & Sanjaya, 2025; Krisnianto, 2022), allowing unauthorized individuals to access sensitive data or functionalities. Insufficient user access management leads to security issues, data errors, and the risk of information misuse in school administrative payments.

A school in Bandung faces similar challenges, hindering both the administration and parents from obtaining payment information securely and quickly. As the volume of transactions and users in the system increases, the complexity of controlling access privileges intensifies. Each user group has unique requirements; for example, students may need to examine only their payment history, whereas administrative personnel require comprehensive access to handle billing data, record payments, and generate reports.

Role-Based Access Control (RBAC) provides an access control model that restricts user access based on predefined roles. Using RBAC, the system correlates user access privileges with designated roles—such as administrator, treasurer, homeroom instructor, and student—thereby enhancing security and operational accuracy. Moreover, RBAC ensures that each user accesses only information and functionalities pertinent to their designated role. This paper seeks to address the current gap by offering a comprehensive case study of the implementation of Role-Based Access Control (RBAC) in a Payment Administration Information System at a school in Bandung. The study aims to provide practical insights for developing safer, more efficient, and customized educational systems. This project aims to provide an efficient, safe, and customized web-based school payment information system for the academic environment in Bandung.

Function, behavioral science characterizes a role as a preordained pattern of an individual's conduct in particular circumstances, dictated by their position. In a role, multiple active participants cooperate to perform designated responsibilities. Each subject adheres to a specified access route throughout a procedure, enabling the system to ascertain whether the user has allowed access. Users complete this verification by providing their identity during the system login process (Rubiyanto et al., 2017).

Role-Based Access Control (RBAC), RBAC functions as a user access control system that safeguards sensitive information assets and facilitates system integration. RBAC ensures that only authorized individuals can access information relevant to their designated duties. Moreover, RBAC provides stringent security by limiting access to information; hence, users are compelled to follow the roles assigned to each individual (Rahman, F., 2021).

Information System, Jogiyanto H.M. defines an information system as a system within an organization that integrates personnel, resources, technology, media, procedures, and controls. This combination seeks to create essential communication channels, facilitate routine transactions, notify management and other stakeholders about important internal and external events, and provide a knowledge base for informed decision-making (Malik et al., 2023).

Educational Administration, school financial administration is the systematic recording and management of institutional finances, conducted with accountability, integrity, transparency, organization, accuracy, effectiveness, and efficiency to fulfill educational objectives as effectively as possible. Financial management in educational institutions largely involves strategic fundraising, fund management, financial administration for annual school programs, and oversight, control, and auditing processes (Yulia, 2025).

Prototyping Methodology, the Prototype Model serves as a method for quickly gathering precise user requirements. Prototyping is an iterative method in which developers rapidly build an initial version or functional model of the system for user assessment. Customers or users subsequently assess this prototype to enhance the software development specifications. This model enables users to comprehend the system's developmental phases, guaranteeing effective system operation. This technique enables the identification of ambiguous or evolving needs while offering users an initial insight into the system's capabilities and interface (Titania Pricillia, 2021).

Unified Modeling Language (UML), UML serves as a standardized modeling language for the design of object-oriented software. It offers a framework for drafting system requirements, encompassing business process concepts, class structures in designated programming languages, database schemas, and essential components inside a software system (Sonata, 2019).

In response to the identified challenges, the author proposes a solution encapsulated in project to create a web-based school administration payment information system utilizing RBAC to enhance user access management.

METHOD

This study used a descriptive methodology. The study employs this strategy to achieve its primary objective: to build and construct a web-based school administration payment information system, utilizing RBAC as the fundamental mechanism for user access management.

Methods of Data Collection, the research employs a dual approach to data collection, comprising document analysis and field research, to ensure a thorough understanding of the operational environment and system needs.

The data-gathering method commences with a comprehensive review of documentation, during which the researcher scrutinizes various internal school documents relevant to payment administration. This entails assessing student data—specifically identities and class information—to create a robust basis for invoicing, in conjunction with reviewing previous payment histories for tuition (SPP) transactions, construction funds, and various supplementary fees. The researcher examines historical financial reports to effectively inform the design of the new system's reporting structure, while meticulously evaluating the Standard Operating Procedures (SOPs) that regulate financial administration and the distribution of responsibilities among the treasurer, administrative staff, and the headmaster. This phase includes a thorough examination of academic literature and previous studies on web-based system development, with particular focus on Role-Based Access Control (RBAC) and the Prototype development approach.

In addition to the desk study, the researcher performs field research by direct investigation at the study location. This field study initially involves structured interviews with relevant stakeholders, including the treasurer, head of administration, headmaster, and parent representatives, to gather detailed insights into the shortcomings of the current payment system, specific user requirements for the new platform, and preferred reporting formats. The researcher conducts direct, on-site observations at Madrasah Ibtidaiyah Swasta (MIS) Unggulan Ad-dimyati. These observations enable the researcher to obtain a direct and precise understanding of the existing school administration payment protocols, ensuring that the devised method adequately addresses actual operational challenges.

System Development Methods, this study utilizes the Prototype technique for system development. The Prototype technique, as part of the Software Development Life Cycle (SDLC), focuses on developing a preliminary version of the system for direct user testing.

This procedure allows developers to obtain prompt input before the final system is fully developed. The development advances through the subsequent principal phases:



Figure 1. Prototype Method

Phases of the Prototyping Methodology, requirement Specification, in the preliminary phase, the researcher collects system-needs data through observation, interviews, and document analysis. This phase generates an exhaustive inventory of system requirements, encompassing role-based access control (super admin, administrative personnel, treasurer, headmaster, and parents), student data management, payment documentation, and financial report generation.

Preliminary Prototype Development, the developer builds a preliminary version of the system that includes essential capabilities, such as login, a streamlined dashboard, and basic access rights management. This prototype, albeit not definitive, illustrates the system's workflow to the users.

Assessment of Users, the school administration, particularly the treasurer and administrative personnel, directly evaluates the developed prototype. Users provide feedback on the interface, functionality, and process flow to ensure compliance with their specific requirements.

Enhancement, in response to user feedback, the developer refines and enhances the prototype. This iterative approach continues until the system fully meets user requirements and adheres to the specified standards.

Execution, upon receiving clearance for the prototype, the developer advances to execute the final system with all functionalities. At this juncture, the developer consolidates all modules—comprising RBAC access management, payment recording, transaction validation, and financial reporting—into a cohesive, production-ready solution.

Evaluation, the completed system undergoes Black-Box Testing and User Acceptance Testing (UAT). These tests ensure that each function complies with user specifications and is free of errors that could hinder the school's payment administration process.

RESULTS AND DISCUSSION

Analysis of the Running System, the researcher creates a Business Process Model and Notation (BPMN) diagram to depict the school's existing payment administration processes in Bandung. This graphic depicts the school's present methodology for payment recording, verification, and reporting, which employs semi-manual procedures that are not fully integrated with web-based technologies.

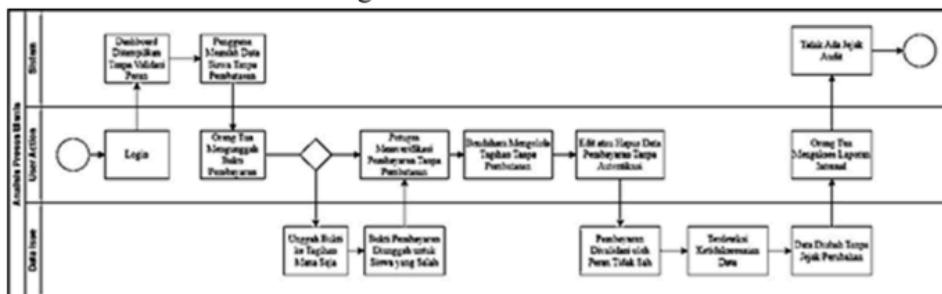


Figure 2. Current BPMN Flowchart

Moreover, the existing system lacks a data change-tracking mechanism (audit trail); thus, the administration is unable to monitor data modification or deletion operations. This absence creates significant vulnerabilities, including unlawful payment validation, data inconsistencies, and unauthorized access to internal information. These situations collectively heighten the likelihood of administrative errors, data loss, and inadequate control of the school's financial operations.

Problem Solving Analysis, the web-based school administration payment information system created for a school in Bandung employs RBAC to manage user access permissions effectively and securely. The system designates a specific role to each user, which dictates their access privileges to data items and system operations. The system administrator or school operator oversees these roles, guaranteeing that each user accesses only data or features commensurate with their designated privileges.

The use of the RBAC method in this study arises from the need for a system that can systematically and safely manage user access permissions. The school's payment information system encompasses various user roles, including Administrative Staff (Admin TU), Treasurer, Headmaster, and Students. Each position entails specific responsibilities and powers that require strict confidentiality and integrity.

This research introduces **Role-Based Access Control (RBAC)** into the web-based payment system to mitigate issues such as data breaches, unauthorized access to features, and the lack of a definitive permission control system. The system automatically limits user access permissions based on the organizational structure through RBAC.

Role Identification, the initial stage delineates all user categories that use the system. In the framework of the Ad-dimyati Flagship MIS, the analysis delineates four principal roles engaging with the system, specifically:

Table 1. Role Identification

No	Role	Description
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1	Super Admin	Manage all system data and features, set user roles, access rights, and monitor system activity.
2	Parent	Access billing information, make payments, view history, and receive notifications.
3	Administrative Admin	Manage user, student, payment, notification, and system data.
4	Treasurer	Verify payment transactions, print reports, and approve payments.
5	Head of Madrasah	Monitor payment status and print overall financial reports.

Access Rights Mapping, once the roles are identified, the next step is to determine the access rights each role has to the features in the system.

Table 2. Access Rights Mapping

Fitur System	Super Admin	Parent	Administrative Admin	Treasurer	Head of Madrasah
Login	✓	✓	✓	✓	✓
Add/Edit User Data	✓		✓		
Add/Edit Student	✓		✓		
Add/Edit Payment Data	✓		✓		
Manage Roles and	✓				
Make a payment	✓	✓			
View Transaction	✓	✓			
Payment Validation	✓			✓	
View Student	✓		✓	✓	✓
Managing Account	✓			✓	
Printing Financial Reports	✓		✓	✓	✓
Logout	✓	✓	✓	✓	✓

The table above illustrates an access control matrix based on Role-Based Access Control (RBAC). Each role column has a checkmark (✓) indicating the features to which it

grants access. RBAC enables the system to automatically limit user access to features that are not pertinent to their position.

Implementation in the System, the system categorizes each authenticated user by their individual function, limiting their visibility and access to pages and features that correspond to their assigned rights. The developer uses the Laravel framework to implement this method, setting up a custom role-check middleware to intercept and filter incoming HTTP requests based on the user's role.

Role Assignment, the system assigns each user a single role upon registration, or an administrator assigns it manually. This assignment is adaptable, allowing dynamic modifications should the user's position change. A specific user_roles table within the system documents the association by mapping the user ID to its respective role.

Table 3. User Roles

User ID	Username	Role
1	Hilmi Fajri	Super Admin
1	Aliefya Ainul Fikri	Administrative Admin
2	Nani Muharromah	Treasurer
3	H. Iik Abdul Chalik	Head of Madrasah
5	Ahmad Fauzi	Parent

This assignment optimizes user administration by transitioning from individual permission allocation to role-based settings. The initial stage determines the authenticated user, usually by extracting this information from the session data created after a successful authentication. This identifier ensures that the system conducts all following validation processes against a properly registered user. Upon user identification, the system retrieves the specific role linked to that user. It performs this lookup through the user_role table, which maintains the association between users and their corresponding roles. When a user holds multiple roles, the system aggregates all permissions granted by those roles.

The next phase obtains the permissions associated with those roles from the role_permission table. The system subsequently assesses the incoming access request against the compiled permission list. Upon identifying a match, the procedure advances to constraint verification. These limits may include value limitations, temporal restrictions, or data ownership boundaries. The system issues an "access permitted" verdict solely when the request meets all specified criteria. If the request breaches any constraint, the system promptly denies access.

1. Super Admin = 1

2. Admin = 2

3. Treasurer = 1

4. Head = 1

5. Parent = 240

Total NU = 245 user

permanent role: 4 role (NR = 4)

unique permissions: 12 (NP = 12)

role-permission assignment: 34 (RPA = 34) according to the access rights matrix.

Table 4. Calculation Method Steps

Parameter	A	Mark
NU	Number of users	245
NR	Number of roles	5
NP	Number of unique permissions	12
URA	User-Role Assignment (1 user = 1 role)	245
RPA	Role-Permission Assignment	33

System Design, the developer uses use cases to depict the principal actions that users of the web-based School Administrative Payment Information System at MIS Unggulan Ad-dimyati can perform based on their designated roles. The system employs the Role-Based Access Control (RBAC) methodology to organize and safeguard user access permissions.

The system architecture classifies users into five specific roles: Super Admin, Administrative Staff (Admin TU), Treasurer, Principal, and Parents. Each actor can access only the aspects that correspond to their designated roles and organizational duties. The use case diagram below specifies the exact steps each user undertakes within the system; however, users must first authenticate using the login interface before commencing any system operations.

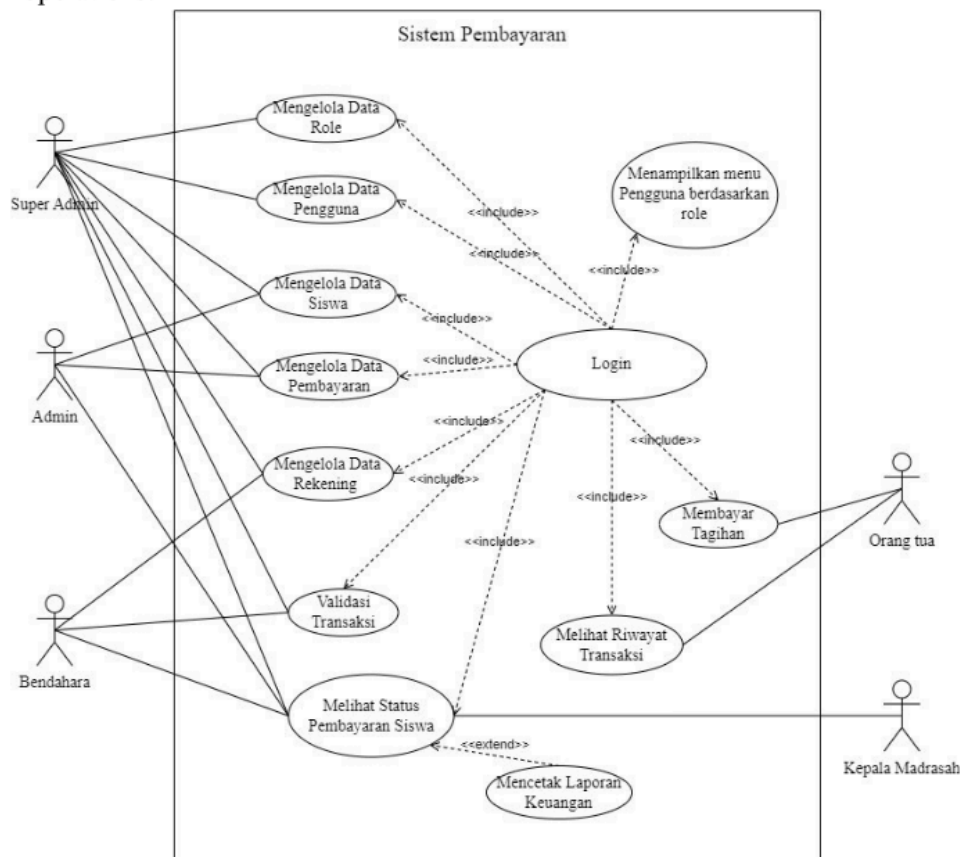


Figure 3. Use Case Diagram

Use Case Scenario

Table 5. Login Specification Use Case

User case: Login

Main actor	Super Admin, Admin, Treasurer, Head of Madrasah, and Parents.
Description	The actor enters the registered username and password to log into the system and access features according to his access rights.

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- E. Activity Diagram
 - F. Sequence Diagram
 - G. Database Table
 - H. Structure Design
 - I. Menu Structure Design
 - J. Interface Design
 - K. Testing

CONCLUSION AND RECOMMENDATION

This research's execution pertains to the technical application of the model and the strategic outcomes attained. The highly accurate prediction model with robust Recall is ideally suited to serve as an Early Warning System for the school.

The subsequent steps for implementation are as follows: The institution consistently updates students' academic and attendance records. Subsequently, the Decision Tree model is executed to produce predictions regarding graduation status (At Risk or Safe). The list of students identified as "At Risk of Not Graduating" is employed by guidance counselors to devise proactive strategies, including intensive tutoring, grade enhancement programs, or disciplinary actions, prior to graduation. Consequently, implementing this model is both technical and operational, facilitating the school's transition from a reactive to a proactive strategy to improve student graduation rates.

Suggestions, in light of the research findings and recognized limitations, the following recommendations are proposed for implementation at a vocational high school in Bandung and for subsequent research endeavors: the school is urged to employ strategic forecasting to develop more proactive intervention techniques. Students identified as "At Risk of Not Graduating" should be prioritized for follow-up via guidance counseling, timely reminders, or academic enhancement initiatives. This methodology can aid guidance counselors by obviating the necessity to manually or arbitrarily identify at-risk students. Secondly, to improve the model's accuracy and generalizability, it is recommended to incorporate

supplementary non-academic predictor variables, such as interest and aptitude test outcomes, learning motivation levels, and socio-economic status. This will facilitate the evaluation of the influence of external factors on graduation rates. Third, it is advisable to investigate alternative machine learning algorithms, such as Random Forest or XGBoost, as they may yield more consistent and precise forecasts than a solitary Decision Tree model. Fourth, implementing time-based validation using longitudinal data (spanning many academic years) would verify that the model's performance remains consistent and relevant despite changes in curriculum or student behavior. Fifth, digitizing the data recording system is vital, as the existing academic data is susceptible to human error and may lack centralization. It is recommended to digitize data and integrate it into the school's academic information system, enhancing accessibility, facilitating updates, and enabling automated analysis. Ultimately, predictive outcomes should be included in an automated reporting system (dashboard) or in notifications (by email/app) dispatched directly to guidance counselors and homeroom instructors. This will expedite the intervention procedure in accordance with the school's response.

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