

Development of Studyforge: A Token Economy Mobile Application Using Performance-Based Currency For Academic Activities Among SPCF Students

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ABSTRACT

This study proposes the development of Studyforge, a token economy mobile application that uses performance-based virtual currency for academic activities among selected students of Systems Plus College Foundation (SPCF). The study aims to provide a structured system for recording measurable academic activities, including attendance, quiz performance, task completion, and timely submission of requirements, and connecting these activities to virtual currency, badges, leaderboards, and reward redemption. The application is designed to provide students with a mobile platform for monitoring their academic participation while allowing authorized faculty members to monitor academic activity records and manage token criteria and rewards. The study will employ a Descriptive-Developmental Research Design with a Quantitative Approach and will use Agile Scrum as the system development methodology. The system will be developed using a mobile application, backend services, APIs, and a centralized database. Unit Testing, Integration Testing, and User Acceptance Testing (UAT) will be conducted to verify the functionality and integration of the system. The developed application will also be evaluated using selected characteristics of the ISO/IEC 25010 Software Quality Model, specifically functional suitability, performance efficiency, usability, and reliability, using a 5-point Likert scale. The proposed Studyforge application is intended to provide an integrated mobile-based token economy that connects measurable academic activities with performance-based virtual currency and predefined rewards while supporting the monitoring of student academic participation.

Keywords: Studyforge, Token Economy, Performance-Based Currency, Gamification, Mobile Application, Academic Activities, Virtual Currency, Reward System, SPCF Students, ISO/IEC 25010

SECTION I — INTRODUCTION (THE PROBLEM AND ITS SETTING)

1.1 Introduction

Technology continues to play an important role in education, with gamification being used to encourage student participation through points, badges, rewards, and leaderboards. Studies show that gamified learning can improve student engagement and academic participation, although its effects may decrease over time because of the novelty effect and differences in how gamification is

implemented (Fodale, 2025; Ratinho & Martins, 2023). Mobile learning applications also provide accessible platforms for supporting academic activities, but factors such as device use and socioeconomic conditions may affect student participation (Pedraza & Canoy, 2025).

To address these concerns, this study proposes Studyforge: A Token Economy Mobile Application Using Performance-Based Currency for Academic Activities Among SPCF Students. The application will use performance-based virtual currency, badges, leaderboards, and reward redemption to record and encourage verifiable academic activities such as attendance, quiz performance, task completion, and timely submission of requirements. Studyforge will also provide system-recorded data that can help faculty and administrators monitor student academic participation. The system will be evaluated using selected criteria from the ISO/IEC 25010 Software Quality Model to assess its functionality, performance, usability, and reliability.

1.2 Background of the Study

The increasing use of digital technology in higher education has encouraged institutions to explore new ways of supporting student participation and academic activities. One approach is gamification, which incorporates game elements such as points, badges, rankings, and rewards into educational environments. Recent systematic reviews have found that gamification is widely applied in higher education and can support student engagement and participation, although its effectiveness varies depending on system design and implementation (Pelizzari, 2023; Khaldi et al., 2023).

A growing area within educational gamification is the use of virtual currency. Unlike ordinary points, virtual currency can represent earned performance and can be exchanged for specific rewards. Cassel et al. (2023) examined virtual currency in educational settings and noted that,

despite the growing use of gamification, virtual currency remains relatively underexplored compared with other game elements. Recent research also emphasizes that gamification outcomes can differ across educational contexts and that engagement does not always result in improved academic outcomes.

These findings point to a need for a more structured system that connects verifiable academic activities with performance-based rewards. Instead of using game elements only for engagement, a token economy can assign virtual currency based on measurable activities such as attendance, quiz performance, task completion, and timely submission of requirements. This leads to the central problem of the study: **How can a mobile-based token economy system using performance-based virtual currency be developed to provide a structured and measurable method of tracking and rewarding students' academic activities?**

To address this problem, the study proposes **Studyforge: A Token Economy Mobile Application Using Performance-Based Currency for Academic Activities Among SPCF Students**. The application will integrate performance-based virtual currency, badges, leaderboards, academic activity tracking, and reward redemption in one mobile platform. It will also record measurable academic activities that can be used by students, faculty, and administrators to monitor participation. The system will be evaluated using selected criteria from the **ISO/IEC 25010 Software Quality Model** to assess its functional suitability, performance efficiency, usability, and reliability.

1.3 Objectives of the Study

The general objective of this study is to design, develop, and evaluate Studyforge, a token economy mobile application that uses performance-based virtual currency to track and reward academic activities among SPCF students.

Specifically, this study aims to:

1. Design and develop a mobile application that integrates performance-based virtual currency, digital badges, and leaderboards for academic activities.
2. Implement an automated token system that awards virtual currency based on predefined and verifiable academic criteria, including attendance, quiz performance, task completion, and timely submission of requirements.
3. Develop a reward redemption system that allows students to exchange earned virtual currency for predefined academic rewards or privileges based on institutional guidelines.
4. Measure student academic activity through system-recorded data, including attendance, task completion, quiz performance, and submission timeliness.
5. Evaluate the software quality of Studyforge using selected characteristics of the ISO/IEC 25010 Software Quality Model in terms of functional suitability, performance efficiency, usability, and reliability.

1.4 Scope and Limitation of the Study

This study focuses on the design, development, and evaluation of Studyforge, a token economy mobile application that uses performance-based virtual currency to support and monitor academic activities among selected students of Systems Plus College Foundation (SPCF). The application will provide features for recording academic activities, awarding virtual currency, displaying badges and

leaderboards, and redeeming earned tokens for predefined academic rewards or privileges. The system will consider verifiable activities such as attendance, quiz performance, task completion, and timely submission of requirements. Studyforge will also provide system-recorded data that can be used to monitor student participation. The software will be evaluated based on selected ISO/IEC 25010 characteristics, specifically functional suitability, performance efficiency, usability, and reliability.

The study is limited to selected SPCF students and academic courses included in the implementation and evaluation of the system. The virtual currency and rewards will be used only within the rules and parameters established for the study and will not have monetary value or be converted into real money. The system will not replace the official grading system, student information system, or other existing academic records of SPCF. It will also not modify official grades, attendance records, or other institutional records. The effectiveness of the system will be assessed only through the academic activities and system-generated data available during the study period. Therefore, the findings may not be directly applicable to other institutions with different academic policies, student populations, or technology environments.

1.5 Significance of the Study

The development of Studyforge may provide benefits to different groups involved in the academic environment. The proposed system is intended to support students, faculty members, school administrators, future researchers, and Systems Plus College Foundation by providing a structured mobile-based approach to recording academic activities and implementing performance-based rewards. The significance of the study for each group is presented below.

Students. Studyforge may provide students with a structured way to monitor their academic activities and earn performance-based virtual currency through attendance, quiz performance, task completion, and timely submission of requirements. The use of virtual currency as a gamification element has been explored as a way of supporting student engagement in educational settings (Cassel et al., 2023).

Faculty. The system may help faculty members monitor student participation through recorded academic activities and submission data. This can provide an organized reference for tracking attendance, task completion, and other measurable activities without relying entirely on manual monitoring.

School Administrators. Studyforge may provide administrators with summarized system records that can support the monitoring of student participation and the implementation of standardized reward policies. This can also provide the institution with an example of how gamification can be integrated into higher education systems. Research on higher education has identified gamification as an increasingly used approach for supporting student engagement and learning experiences (Pelizzari, 2024).

Future Researchers. The study may serve as a reference for researchers who plan to investigate token economies, virtual currency, gamification, and mobile applications in education. Since virtual currency remains less explored than other gamification elements, Studyforge may provide a basis for further research on performance-based reward systems in higher education (Cassel et al., 2023).

SPCF. The proposed system may provide Systems Plus College Foundation with a locally developed model for using a mobile-based token economy to record and reward academic

participation. It may also contribute to the institution's exploration of technology-supported approaches for monitoring student academic activities.

1.6 Definition of Terms

The following terms are defined operationally as they are used in this study. These definitions are provided to clarify the specific meaning of the terms within the context of the proposed Studyforge mobile application. They describe how each term is applied in the development, implementation, and evaluation of the system.

- **Academic Activities.** These refer to the school-related tasks and activities recorded by Studyforge, including attendance, quizzes, task completion, and timely submission of requirements.
- **Academic Privileges.** These refer to predefined benefits or opportunities that students may receive by redeeming earned virtual currency, subject to the rules and policies established for the study.
- **Badges.** These are digital achievements displayed in Studyforge to recognize students for completing specific academic activities or reaching predefined performance criteria.
- **Gamification.** This refers to the use of game-related elements, such as points, badges, leaderboards, and rewards, within Studyforge to support student participation in academic activities.
- **ISO/IEC 25010.** This refers to the software quality model used in the study to evaluate selected aspects of Studyforge, particularly functional suitability, performance efficiency, usability, and reliability.

- **Leaderboard.** This refers to a feature of Studyforge that displays student rankings based on accumulated virtual currency or other predefined performance measures.
- **Mobile Application.** This refers to the software application developed for mobile devices to provide students and authorized users with access to Studyforge's academic activity tracking, virtual currency, and reward features.
- **Performance-Based Currency.** This refers to the virtual currency in Studyforge that is awarded to students based on predefined and verifiable academic activities, such as attendance, quiz performance, task completion, and timely submission of requirements.
- **Reward Redemption.** This refers to the process of exchanging earned virtual currency for predefined academic rewards or privileges available within Studyforge.
- **SPCF Students.** These refer to the selected students of Systems Plus College Foundation who will participate in the implementation and evaluation of Studyforge.
- **Token Economy.** This refers to the reward system implemented in Studyforge in which students earn virtual tokens for specified academic activities and may exchange accumulated tokens for predefined rewards or academic privileges.
- **Virtual Currency.** This refers to the digital tokens used within Studyforge to represent earned performance and participation. The currency has no monetary value and cannot be exchanged for real money.

SECTION II — LITERATURE REVIEW

2.1 Introduction to the Review

This chapter presents the review of related literature and studies relevant to the development of Studyforge: A Token Economy Mobile Application Using Performance-Based Currency for

Academic Activities Among SPCF Students. The review focuses on recent research concerning gamification in education, mobile and digital learning, token economy systems, virtual currency, student academic participation, and software quality evaluation.

Gamification has become an increasingly studied approach in higher education, particularly through the use of points, badges, leaderboards, rewards, and other game elements. Recent systematic reviews have examined its application in higher education and reported its potential to support student engagement and learning experiences, while also emphasizing that outcomes may vary depending on the design and context of implementation (Khaldi et al., 2023; Pelizzari, 2024).

Recent research has also examined specific gamification elements and their effects on students. Li et al. (2024) found that gamification can produce positive effects on some student-related outcomes, while Hong et al. (2024) emphasized the importance of tailoring gamification elements to learners and educational contexts. These findings suggest that gamification systems should be carefully designed rather than relying on a single game element.

Another area relevant to the present study is the use of token economy and virtual rewards. Token economy approaches have been studied as structured reward systems for supporting learning-related behaviors and engagement (Kim et al., 2022). Recent research on digital learning has also continued to examine how gamified systems and reward mechanisms can support student participation. These studies provide a foundation for exploring a performance-based virtual currency system that connects measurable academic activities with predefined rewards.

The succeeding sections therefore examine the concepts, applications, benefits, and limitations of gamification, token economy systems, virtual currency, mobile learning applications, academic activity monitoring, and software quality evaluation. The reviewed literature will be used to identify

existing approaches and gaps that support the development of Studyforge as a mobile-based token economy system for SPCF students.

2.2 Review of Related Literature and Studies

2.2.1. Gamification in Education

Gamification has become increasingly used in education to make learning activities more interactive through game elements such as points, badges, rewards, and leaderboards. Studies in higher education show that gamification can support student participation and improve learning experiences, although its effects may vary depending on the learning environment and the elements used (Aguilos & Fuchs, 2022; Khaldi et al., 2023; Ratinho & Martins, 2023). A systematic review also identified rewards as one of the most frequently used game elements, while leaderboards can provide students with information about their performance and progress (Hong et al., 2024; Li, C. et al., 2024). Other research has examined the effects of gamification on students' perceptions and learning experiences, further supporting the use of game elements in educational settings (Li, L. et al., 2024).

2.2.2. Mobile Applications in Education

Mobile applications provide accessible and flexible platforms for educational activities. A systematic review found that mobile learning applications have become useful resources in online higher education by allowing students to access learning activities through mobile devices (Rangel-de Lazaro & Duarte, 2023). Mobile applications can also be used for assessment, as demonstrated by a mobile game application developed for Biology learning (Bien, 2023). In addition, educational mobile applications can be evaluated using software quality characteristics such as functional

suitability, performance efficiency, usability, and reliability (Delay, 2023). These findings support the use of mobile applications as platforms for academic activities and gamified features.

2.2.3. Token Economy and Virtual Currency in Education

Virtual currency can be used as a digital reward that students earn through participation in educational activities. A multi-case study examined virtual currency in educational settings and found that it can provide a structured way of rewarding academic practice (Dicheva et al., 2023). Similarly, Marchuk et al. (2023) developed a student reward system that uses virtual currency as a learning incentive. These studies demonstrate how virtual currency can be incorporated into educational systems as a reward mechanism. A framework for organizing rewards in gamified environments also emphasizes the importance of systematically structuring rewards within digital systems (Pereira & Tremblay-Savard, 2026).

2.2.4. Performance-Based Rewards

Performance-based rewards connect incentives to measurable academic activities or achievements. A meta-analysis of higher education studies found that performance-based financial incentives can improve academic outcomes such as credits earned, GPA, and examination scores (Lintner, 2024). Although financial incentives differ from Studyforge's virtual currency, the findings support the concept of connecting rewards to measurable performance. Research comparing tangible and intangible rewards also found that reward type can influence students' behavioral and cognitive engagement in gamified learning (Xiao & Hew, 2024). More recent research found that low-stakes and performance-contingent rewards may be associated with improved academic performance, although the evidence remains dependent on the design and context of the reward system (Bai et al., 2026).

2.2.5. Academic Activity Monitoring

Monitoring academic activities allows educational systems to collect information about student participation and learning behaviors. A systematic review of learning analytics found that student engagement can be examined through data collected from digital learning environments, including observable learning activities (Bergdahl et al., 2024). Similarly, a meta-analysis found a positive relationship between learning engagement and learning outcomes in online higher education (Doo & Kim, 2024). These findings show the importance of recording student activities as measurable information. For Studyforge, activities such as attendance, quiz performance, task completion, and timely submission can be used as measurable criteria for awarding virtual currency.

2.2.6. Gamification Elements and Reward Systems

Different gamification elements can be combined to create structured educational environments. Research on online learning found that different gamification components can affect learner engagement, showing the importance of selecting appropriate elements when designing a gamified system (Meng et al., 2024). Rewards are among the most commonly identified game elements in digital gamification, while leaderboards can provide performance-related feedback to students (Hong et al., 2024; Li, C. et al., 2024). Virtual currency can further connect these elements by providing students with rewards that are earned through academic activities (Dicheva et al., 2023; Marchuk et al., 2023). Therefore, virtual currency, badges, leaderboards, and reward redemption can be integrated into one educational application.

2.2.7. Gamification and Academic Activities

Gamification can also be applied to specific academic activities such as studying, assessment, attendance, and task completion. Torres-Munares et al. (2024) found that combining gamification with a structured study method supported university students' time management and academic activities through a mobile application. Reward systems have also been applied to attendance-related behavior. For example, Montederamos (2024) used a strategic reward system based on attendance records and reported a significant reduction in student tardiness. These studies show that measurable academic behaviors can be connected to digital or structured reward systems.

2.2.8. Gamification in the Philippine Educational Context

In the Philippine context, gamification has been studied in different educational settings. Marcaida et al. (2022) examined a gamified virtual environment among senior high school students in Pampanga and identified its influence on classroom engagement as well as challenges in using gamified instruction. Nob et al. (2024) reviewed the use of gamification in Philippine mathematics education and discussed its potential in supporting learning experiences. In higher education, Pajarito et al. (2024) examined gamification as an approach to the learning process, while Pacturan et al. (2024) investigated the integration of gamification in teaching and its relationship with academic performance. These studies show that gamification has already been explored in several areas of Philippine education.

2.2.9. Gamification in Philippine Higher Education

Philippine higher education institutions have also explored the use of digital gamification. Duterte (2024) examined gamification among undergraduate students from private universities in Manila using elements such as points, badges, leaderboards, and collaborative challenges. Similarly, Moldez et al. (2024) developed and assessed gamification within University of the Philippines Open

University Massive Open Online Courses using features such as badges, leaderboards, and progress indicators. These studies demonstrate that gamification can be applied to Philippine higher education through digital platforms and multiple game elements.

2.2.10. Challenges and Considerations in Gamification

Although gamification can support educational activities, its effects may differ depending on the elements selected and how they are implemented. Research has found that gamification strategies can produce varying outcomes across educational settings (Ratinho & Martins, 2023). The selection and combination of game elements are also important because different components may produce different effects on learner engagement (Meng et al., 2024). In addition, research on leaderboards found that their effectiveness depends on their design and the way performance information is presented (Li, C. et al., 2024). Reward systems should therefore use clear and measurable criteria to ensure that students understand how rewards are earned.

2.2.11. Software Quality of Educational Mobile Applications

Software quality is important when developing educational mobile applications because the system must perform its intended functions while remaining usable and reliable. Delay (2023) evaluated an educational mobile application using ISO 25010 characteristics, including functional suitability, performance efficiency, usability, reliability, security, maintainability, and portability. This provides a relevant basis for evaluating educational mobile applications. For Studyforge, selected ISO/IEC 25010 characteristics, specifically functional suitability, performance efficiency, usability, and reliability, will be used to evaluate the developed

2.3 Conceptual Framework

The conceptual framework of Studyforge is based on the reviewed literature on gamification, virtual currency, performance-based rewards, academic activity monitoring, and mobile educational applications. Gamification elements such as badges, leaderboards, and rewards have been widely used in educational settings, while virtual currency can provide a structured way of rewarding students for academic activities (Khaldi et al., 2023; Hong et al., 2024; Li, C. et al., 2024; Dicheva et al., 2023; Marchuk et al., 2023). Performance-based rewards can also be connected to measurable academic activities, such as attendance and academic performance (Lintner, 2024; Montederamos, 2024). Based on these concepts, the framework follows an Input–Process–Output (IPO) model.

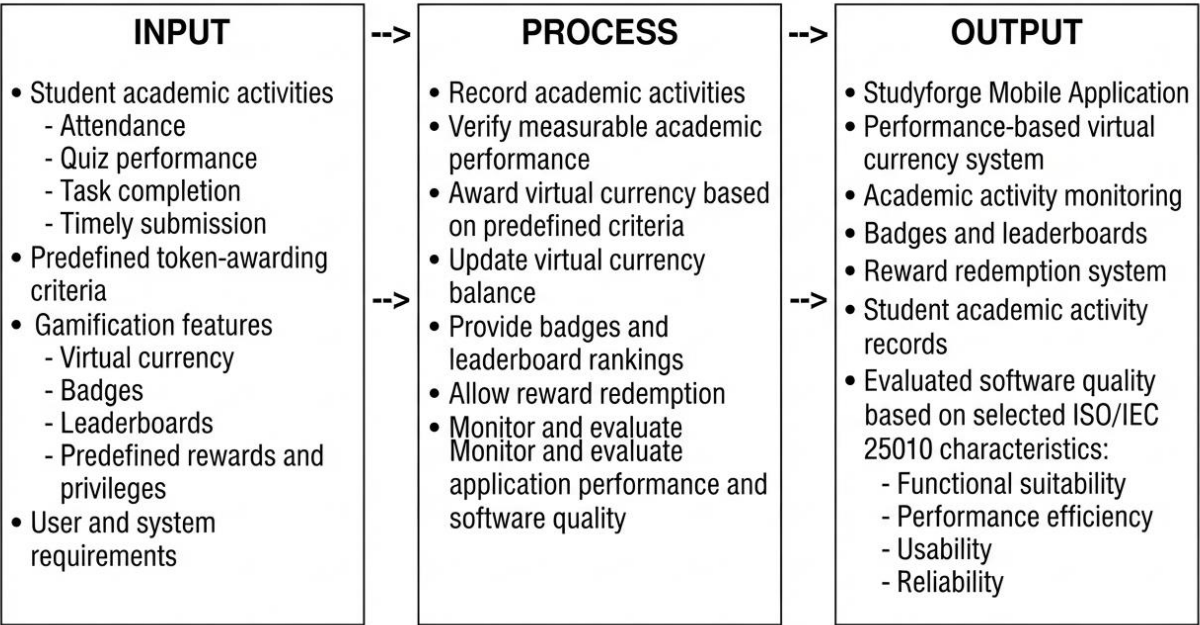


Figure 1. Conceptual Framework

The Input consists of the students’ academic activities, including attendance, quiz performance, task completion, and timely submission. It also includes the predefined criteria for awarding virtual currency, gamification features such as virtual currency, badges, and leaderboards, predefined

rewards and privileges, and the user and system requirements. These inputs provide the information and requirements needed for the development of the Studyforge application.

The Process involves recording and verifying students' academic activities based on the established criteria. The system then awards virtual currency according to the students' recorded performance, updates their virtual currency balance, provides badges and leaderboard rankings, and allows students to redeem available rewards. The application is also evaluated based on selected software quality characteristics, including functional suitability, performance efficiency, usability, and reliability.

The Output is the developed Studyforge mobile application. It provides an integrated system for monitoring academic activities, awarding performance-based virtual currency, displaying badges and leaderboards, and managing reward redemption. The resulting application is intended to provide a structured token economy system for academic activities among SPCF students.

2.4 Synthesis

The reviewed literature establishes that gamification can be used to organize and enhance academic activities through measurable game elements such as points, badges, leaderboards, and rewards. Studies have shown that these elements can support student participation and provide feedback about academic progress, but their effects can differ depending on the type and combination of features used (Khaldi et al., 2023; Hong et al., 2024; Meng et al., 2024; Li, C. et al., 2024). This suggests that gamification should not simply add game features to an educational application; instead, the features should have clear purposes and be connected to actual academic activities.

The literature on virtual currency provides another important perspective. Unlike simple points that primarily indicate progress, virtual currency can function as a reward that students earn and use within a structured system (Dicheva et al., 2023; Marchuk et al., 2023). When combined with performance-based criteria, the currency can create a direct connection between a student's recorded academic activity and the rewards available in the system. Studies on performance-based incentives and reward strategies further indicate that rewards can be connected to measurable academic outcomes, although their effectiveness depends on how the reward system is designed and implemented (Lintner, 2024; Xiao & Hew, 2024; Bai et al., 2026). This provides a basis for treating academic activities not only as records to be monitored but also as measurable conditions for earning virtual currency.

The reviewed studies on mobile learning and academic activity monitoring further show that mobile applications can provide accessible platforms for recording, managing, and monitoring educational activities (Rangel-de Lazaro & Duarte, 2023; Bien, 2023; Bergdahl et al., 2024). Student activities such as attendance, quiz performance, task completion, and submission behavior can therefore be recorded as measurable information within a digital system. From this perspective, a mobile application can serve not only as a platform for displaying gamification features but also as a system that connects academic activity records with a structured reward mechanism.

In the Philippine educational context, existing studies demonstrate that gamification has been applied in different areas, including senior high school, mathematics, and higher education (Marcaida et al., 2022; Nob et al., 2024; Pajarito et al., 2024; Pacturan et al., 2024; Duterte, 2024; Moldez et al., 2024). However, these studies generally focus on the use of gamification for learning, engagement, academic performance, or specific educational activities. The reviewed literature provides less evidence of a Philippine higher education mobile application that combines multiple

academic activity criteria with performance-based virtual currency, badges, leaderboards, and reward redemption in one system.

Based on these findings, the main gap is not the absence of gamification or rewards in education, but the limited integration of these concepts into one measurable academic reward system. Existing studies commonly examine gamification elements, virtual currency, performance-based incentives, mobile learning, and academic monitoring as separate components. Studyforge takes a different perspective by treating these components as connected parts of one token economy: academic activities serve as measurable bases for earning virtual currency; accumulated currency can be exchanged for predefined rewards; and badges and leaderboards provide additional ways of displaying academic progress and achievement.

Therefore, the proposed Studyforge application addresses the identified gap by integrating academic activity monitoring, performance-based virtual currency, gamification elements, and reward redemption into a single mobile platform for SPCF students. The study also emphasizes measurable and predefined criteria rather than relying on subjective outcomes. This provides a more structured approach in which students' recorded academic activities are directly connected to the earning and use of virtual currency. The proposed system consequently offers a localized application of established gamification and reward concepts while providing an integrated model that can be evaluated according to selected software quality characteristics.

SECTION III — METHODOLOGY

3.1 Research Design

This study employs a Descriptive-Developmental Research Design with a Quantitative Approach. The developmental aspect focuses on the planning, design, development, and implementation of the

Studyforge mobile application as a token economy system for academic activities among SPCF students. The system will integrate performance-based virtual currency, badges, leaderboards, academic activity monitoring, and reward redemption based on predefined criteria.

The descriptive-quantitative aspect focuses on evaluating the developed application using measurable data. The system will be evaluated based on selected ISO/IEC 25010 software quality characteristics, specifically functional suitability, performance efficiency, usability, and reliability. Quantitative data will be gathered from the evaluation of the system and analyzed to determine whether the developed application meets its intended requirements and functions effectively for its target users.

Through this research design, the study will not only develop the proposed Studyforge application but also provide measurable evidence regarding its software quality and performance. This approach allows the researchers to systematically develop the application and assess its effectiveness based on defined and observable criteria.

3.2 System Development Methodology

The study will utilize the Agile Scrum methodology to guide the development of the Studyforge mobile application. The development will be organized into iterative sprints, allowing the researchers to plan, develop, test, and improve the system's features progressively. The major features, including academic activity recording, performance-based virtual currency, badges, leaderboards, and reward redemption, will be developed and tested throughout the development process. Feedback gathered during testing will be used to identify issues and make necessary improvements to the application.

The study will involve selected SPCF students as target users and evaluators, along with selected faculty members who can provide feedback regarding the academic activities and reward criteria implemented in the system. Participants will be selected based on their relevance to the intended use of the application. The researchers will gather data through system testing, user evaluation questionnaires, and observation of the application's functions during testing.

The collected quantitative data will be used to evaluate the developed application based on the selected ISO/IEC 25010 characteristics of functional suitability, performance efficiency, usability, and reliability. The results will be analyzed using appropriate descriptive statistical measures to determine the overall software quality of the Studyforge mobile application.

3.3 Requirement Specification and Analysis

This section presents the functional requirements and system processes of the proposed Studyforge mobile application for managing academic activities through a performance-based token economy system among SPCF students.

The requirement analysis focuses on the functions needed to manage student academic activities, performance-based virtual currency, badges, leaderboards, reward redemption, and professor monitoring.

The system processes and data relationships are represented through the Data Flow Diagram (DFD) and Entity-Relationship Diagram (ERD). The DFD illustrates how information moves between Students, Professors, and the Studyforge system. The ERD presents the main entities and their relationships within the system database. The flowcharts are also used to illustrate the overall

system process and the process of recording academic activities, awarding performance-based virtual currency, checking badge requirements, and updating student progress.

3.3.1 Functional Requirements

The system's functionalities include allowing Students and Professors to access their respective functions through user authentication, allowing Students to view their academic activities, rewards, and profile information, and allowing Professors to monitor student activities and manage token criteria and rewards. The system also records academic activities, identifies the activity type, applies predefined token criteria, determines and awards the appropriate amount of virtual currency, and updates the student's token balance. In addition, the system checks badge requirements, awards badges when requirements are met, and updates the student's academic activity, token, and badge records to display their progress.

3.3.2 Data Flow Diagram

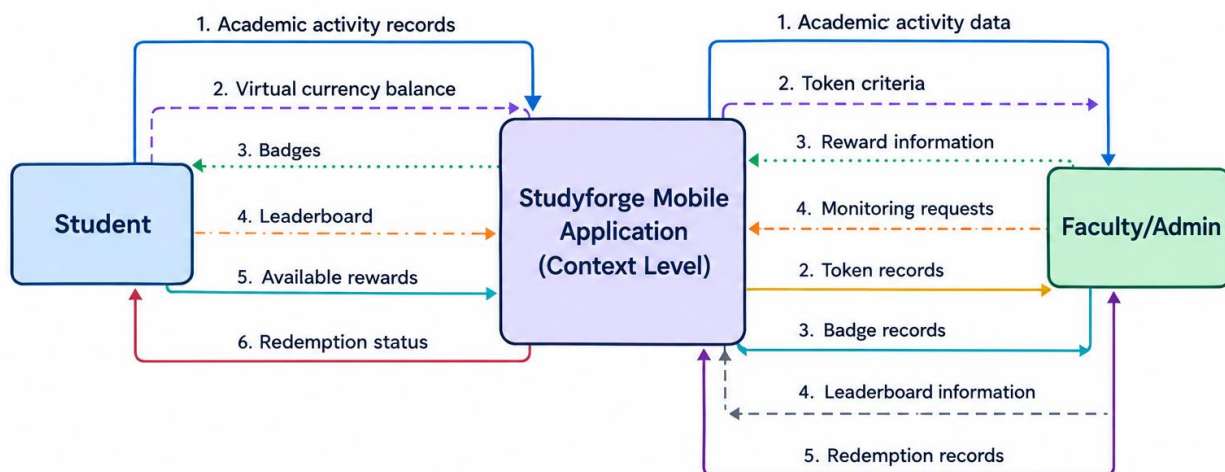


Figure 2. Data Flow Diagram Level 0 - Context Diagram

This context diagram shows how the proposed Studyforge mobile application exchanges information with the Student and Professor. It presents where the information comes from, how it is processed by the system, and what information is provided back to the users. The Student provides login credentials to access the application and interacts with the system to view academic activities, virtual currency, badges, leaderboard information, rewards, and redemption status. The system receives the student's information and academic activity records and processes them according to the predefined criteria of the application.

The Student provides academic activity information through activities such as attendance, quiz performance, task completion, and timely submission. These records are processed by the Studyforge system to determine the appropriate amount of performance-based virtual currency. The system also checks the student's recorded achievements against the predefined badge requirements. After processing the information, the system updates the student's token balance and progress and provides the student with their academic activity records, earned virtual currency, badges, leaderboard information, available rewards, and redemption information.

The Professor provides the system with academic activity information and manages the predefined token-awarding criteria and available rewards. These criteria are used by the Studyforge system to determine how many tokens should be awarded based on a student's recorded academic performance or completed activity. The Professor can also access student academic activity records, token records, badge information, leaderboard information, and reward redemption records for monitoring purposes. The information provided to the Professor allows them to monitor the students' recorded academic activities and manage the criteria and rewards used within the system.

The Studyforge system serves as the main processing system that receives information from both the Student and Professor. It processes academic activity records, applies the predefined token criteria, updates token balances, checks badge requirements, and manages the information related to rewards and student progress. The system then returns the appropriate processed information to the Student and Professor based on their respective functions and access.

In conclusion, the context diagram shows the overall exchange of information between the Student, Professor, and Studyforge mobile application. It illustrates how student academic activities and professor-defined criteria are provided to the system, processed according to the system requirements, and returned as updated academic activity, virtual currency, badge, leaderboard, reward, and monitoring information.

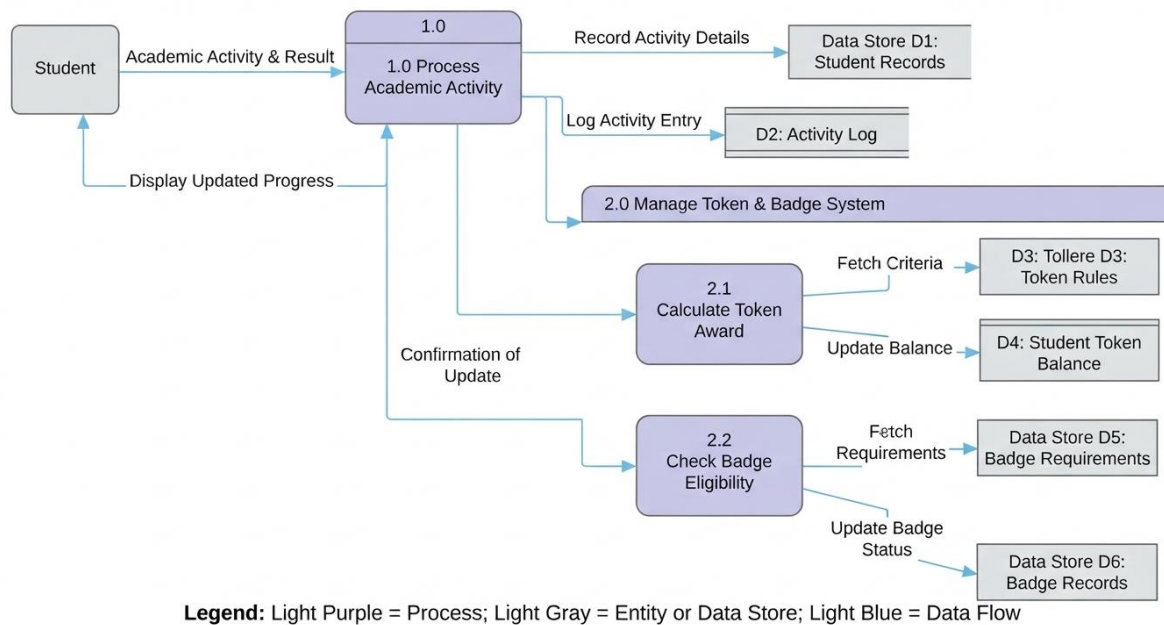


Figure 3. Data Flow Diagram Lvl 1

Figure 3 presents the Level 1 Data Flow Diagram (DFD) of the proposed Studyforge mobile application. It provides a more detailed representation of how information is processed within the system by breaking down the main system into specific processes and data stores. The diagram shows the flow of information between the Student, Professor, the system processes, and the records maintained by the application.

The User Authentication process handles the login information provided by the Student and Professor and verifies their credentials before allowing access to the appropriate functions of the system. The Academic Activity Management process records and manages information related to student attendance, quiz performance, task completion, and timely submission. These academic activity records are stored and used as the basis for the succeeding processes within the system.

The Token Management process receives the recorded academic activity information and checks it against the predefined token criteria. Based on the student's recorded performance or completed activity, the system determines the appropriate amount of virtual currency to award and updates the student's token balance. The token transactions are recorded in the system so that the earned and used virtual currency can be properly monitored.

The Badge and Leaderboard Management process uses the student's academic activity and token information to determine whether the requirements for specific badges have been met and to update the student's leaderboard information. When a student meets a predefined badge requirement, the corresponding badge is recorded in the system. The leaderboard information is also updated based on the criteria established for ranking students.

The Reward Redemption process allows the Student to view available rewards and submit a redemption request using their earned virtual currency. The system checks the student's available

token balance before processing the request and records the redemption information. This process ensures that reward redemptions are properly recorded and that the student's token balance is updated after a successful transaction.

The Administration and Monitoring process allows the Professor to access and monitor student academic activity records, token records, badge information, leaderboard information, and redemption records. The Professor can also manage the token-awarding criteria and available rewards used by the system. These functions allow the Professor to maintain the criteria and reward information needed for the proper operation of Studyforge.

Overall, the Level 1 DFD shows how information moves through the major processes and data stores of the Studyforge mobile application. It provides a more detailed view of how user information, academic activities, tokens, badges, leaderboard information, rewards, and redemption records are received, processed, stored, and retrieved within the system.

3.3.3 Entity-Relationship Diagram

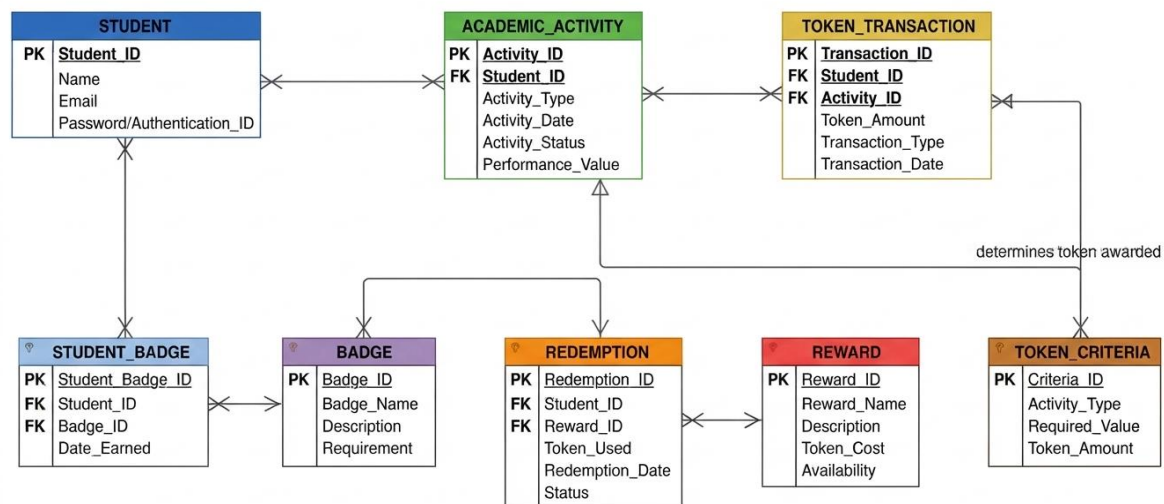


Figure 4. Entity-Relationship Diagram (ERD)

The Entity-Relationship Diagram (ERD) illustrates the database structure of the proposed Studyforge mobile application. It shows the main entities used to store and organize the information required by the system and defines the relationships between these entities. The Student entity stores the basic information of each student, while the Academic Activity entity records activities such as attendance, quiz performance, task completion, and timely submission.

The Academic Activity entity is connected to the Token Transaction entity, which records the virtual currency earned from completed academic activities based on the predefined token criteria. The Student entity is also connected to the Student Badge entity, which records the badges earned by students based on the requirements defined for each Badge. The Reward entity contains the available rewards and their corresponding token costs, while the Redemption entity records the rewards redeemed by students using their earned virtual currency.

These relationships allow the system to connect each student's academic activities with their earned tokens, badges, and redeemed rewards. The ERD provides the database structure needed to organize student information, academic activity records, token transactions, badge achievements, rewards, and redemption records in a consistent manner. Overall, it serves as a guide for designing and managing the database of the Studyforge mobile application.

3.3.4 Flowchart

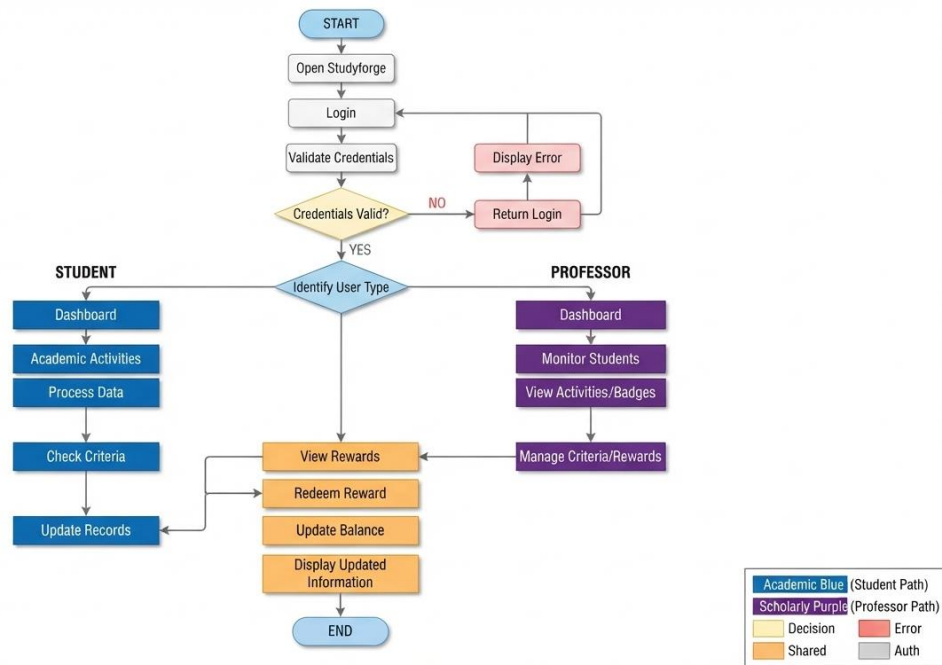


Figure 5. Overall System Flowchart

The overall system flowchart illustrates the general process of the proposed Studyforge mobile application, starting from user login and account validation. After entering their credentials, the system verifies the account and identifies whether the user is a Student or Professor. The Student is then directed to the student dashboard, where they can access academic activities, rewards, and profile information, while the Professor is directed to the professor dashboard, where they can monitor student activities and manage token criteria and rewards.

For Students, the flowchart shows how they can access their academic activity records, view available rewards, redeem rewards using their earned virtual currency, and view their profile information. The system processes the student's recorded activities based on the predefined token criteria and updates the student's token balance and records. For Professors, the flowchart shows

how they can monitor student academic activities and view token, badge, and leaderboard information, as well as manage the criteria and rewards used by the system.

Overall, the flowchart provides a general view of how users interact with the Studyforge mobile application and how the system directs each user to their respective functions. It also shows how the application processes and displays updated information based on the actions performed by Students and Professors.

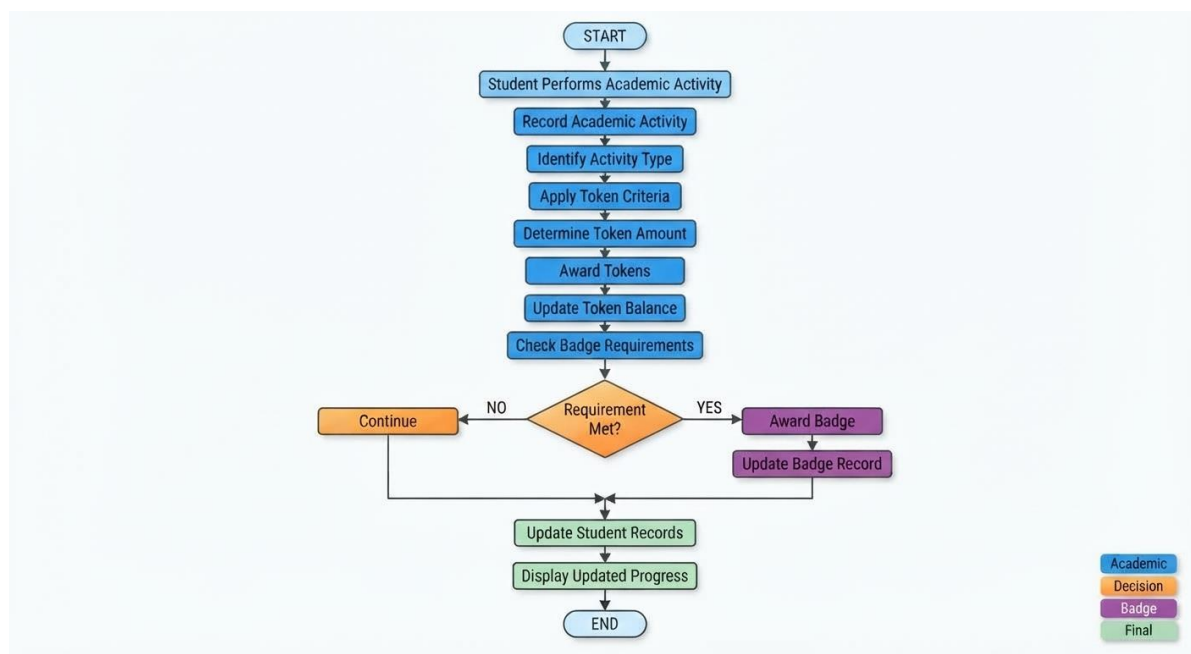


Figure 6. Academic Activity–Token Flowchart

The academic activity–token flowchart illustrates the process of how the Studyforge mobile application records a student’s academic activity and converts the recorded performance into virtual currency. The process begins when the Student performs an academic activity, such as attendance, quiz performance, task completion, or timely submission. The system records the activity, identifies

its type, and applies the predefined token criteria to determine the appropriate amount of virtual currency.

After determining the token amount, the system awards the corresponding tokens to the Student and updates the student's token balance. The system then checks whether the Student meets the requirements for a specific badge. If the requirements are met, the system awards the badge and updates the badge record. If the requirements are not met, the system continues without awarding a badge.

After the badge checking process, the system updates the Student's records and displays the updated academic activity, token balance, and badge progress. Overall, the flowchart shows how recorded academic activities are processed using predefined criteria and connected to the earning of virtual currency and badges within the Studyforge mobile application.

3.4 System Design Specification

The logical specification defines the user interface, system modules, and processes of the application. The Student interface includes the dashboard, academic activities, virtual currency balance, badges, leaderboard, rewards, redemption, and profile. The Professor interface includes student activity monitoring, token criteria management, and reward management. The physical specification defines the hardware, software, database, backend services, and network resources required to develop and operate the application.

The system follows a mobile application architecture designed to support academic activity monitoring through a performance-based token economy. The mobile application allows students to access their academic activity records, earn virtual currency based on predefined performance

criteria, receive badges, view leaderboard rankings, and redeem available rewards. Professors can monitor student academic activities and manage the token-awarding criteria and available rewards through the system. The recorded academic activities are processed by the system to determine the appropriate amount of virtual currency and evaluate whether students meet the requirements for specific badges. The system does not modify official academic grades or records. The system design and data flow are based on the requirements identified for the proposed application.

Major Components

1. **Student Mobile Application** – Allows students to access their accounts, view their academic activities, monitor their virtual currency balance, view earned badges and leaderboard rankings, check available rewards, redeem rewards, and view their profile information.
2. **Professor Management Interface** – Allows professors to monitor student academic activities, view token and badge records, check leaderboard information, and manage the predefined token-awarding criteria and available rewards.
3. **Academic Activity Management Module** – Records and manages student academic activities, including attendance, quiz performance, task completion, and timely submission. The recorded activities serve as the basis for determining the appropriate virtual currency.
4. **Token Management Module** – Applies the predefined token criteria to the recorded academic activities and determines the appropriate amount of virtual currency to award. The module updates the student's token balance and maintains token transaction records.

5. **Badge and Leaderboard Module** – Checks student records against the predefined badge requirements and awards badges when the requirements are met. The module also updates and displays leaderboard information based on the criteria implemented in the system.
6. **Reward and Redemption Module** – Manages the available rewards and their corresponding token costs. It allows students to redeem eligible rewards using their earned virtual currency and records each redemption transaction.
7. **Centralized System Database** – Stores user information, academic activity records, token transactions, badge achievements, leaderboard information, reward details, redemption records, and the predefined criteria required for the operation of the system.
8. **Backend Services** – Handles communication between the mobile application and the centralized database. It processes user authentication, academic activity records, token transactions, badge evaluation, leaderboard updates, and reward redemption.
9. **Hardware Requirements** – The system requires compatible Android mobile devices for students and computers for professors and system management. The devices must have sufficient processing capability, storage, and network connectivity to support the application.
10. **Software and Network Requirements** – The system requires the selected mobile development tools, backend technologies, database management system, and a stable internet connection. These components support the development, deployment, communication, and synchronization of information between the mobile application, backend services, and centralized database.

3.5 Implementation

The Studyforge mobile application will be developed to provide students with a mobile platform for monitoring academic activities and participating in a performance-based token economy. The application will allow students to access their recorded academic activities, virtual currency balance, earned badges, leaderboard information, available rewards, redemption records, and profile information. Professors will have access to functions for monitoring student academic activities and managing the predefined token-awarding criteria and available rewards. The implementation will follow the system requirements and design specifications established for the proposed application.

The mobile application will be developed using the selected mobile development tools and programming technologies. The application code will be organized into separate components according to their functions, including user authentication, student dashboard, academic activity management, token management, badge management, leaderboard management, reward management, redemption, profile management, and professor monitoring. This organization will allow each component to perform its specific function while maintaining proper communication with the other parts of the system. The backend services will contain the functions responsible for processing requests, applying token criteria, managing system records, and communicating with the centralized database.

The centralized database will be configured to store the information required by the Studyforge system. Database tables will be created for user accounts, student information, academic activities, token transactions, badges, student badge records, rewards, and redemption transactions.

Appropriate primary keys and foreign key relationships will be established based on the Entity-Relationship Diagram (ERD). This structure will allow the system to properly associate each student's academic activities with the corresponding virtual currency, badges, rewards, and

redemption records. The database will also store the predefined token criteria and other system configurations when these are required to be managed through the application.

The mobile application will communicate with the backend services through Application Programming Interfaces (APIs). API requests will be used to securely send and retrieve authorized information between the mobile application and the backend. When a student performs or receives a recorded academic activity, the relevant information will be sent to the backend for processing. The backend will identify the activity type, apply the corresponding predefined token criteria, determine the token amount, and record the resulting token transaction in the database. The updated token balance will then be returned to the mobile application for display to the student.

The implementation of the academic activity and token process will follow the criteria established by the researchers and authorized personnel. Academic activities such as attendance, quiz performance, task completion, and timely submission will be recorded according to the implemented system requirements. The system will evaluate the recorded activity using predefined and measurable conditions before awarding virtual currency. Different token amounts may be assigned according to the established criteria, allowing the **system to record the** appropriate reward for each completed activity. Each successful token transaction will update the student's token balance and maintain a corresponding record in the database.

The badge and leaderboard components will also be integrated with the academic activity and token records. After processing an academic activity, the system will check whether the student's records meet the predefined requirements for available badges. If the requirements are satisfied, the corresponding badge will be awarded and recorded in the database. The leaderboard will use the information defined by the system to update and display student rankings. These components will

be connected to the student's academic activity and token information so that the displayed progress remains consistent with the records stored in the system.

The reward and redemption component will be implemented to allow students to view available rewards and their corresponding token costs. When a student selects a reward, the system will verify whether the student's token balance is sufficient. If the required number of tokens is available, the system will record the redemption transaction and deduct the corresponding tokens from the student's balance. The redemption status and transaction details will also be stored in the database for monitoring and recordkeeping. Professors will be provided with access to the applicable reward management functions based on their authorized system privileges.

The Professor functions will be implemented to support the monitoring and management of the token economy system. Authorized Professors will be able to view student academic activity records, token transactions, badge information, leaderboard information, and redemption records available within the system. They will also be able to manage the **predefined** token-awarding criteria and available rewards according to the functions included in the application. Access to these functions will be controlled through user authentication and role-based permissions to prevent unauthorized users from accessing management features.

Before deployment, the system will be configured with the required user roles, token-awarding criteria, badge requirements, leaderboard rules, and available rewards. Sample or authorized academic activity records will be used during development and testing to verify that the system correctly records activities, applies token criteria, updates balances, evaluates badges, displays leaderboard information, and processes reward redemptions. Testing will be performed in a

controlled environment to identify functional errors, integration problems, data inconsistencies, and issues in the interaction between the mobile application, backend services, and database.

If existing academic activity information is required during implementation, only authorized or properly prepared sample data will be used. Data will be entered or imported into the system using structured procedures that maintain the required database relationships and data formats. The implementation will not alter official academic grades, attendance records, or other institutional records. Any use of actual student information will remain subject to the appropriate institutional authorization, privacy requirements, and applicable data protection policies.

The completed Studyforge system will be deployed as a mobile application connected to its backend services and centralized database. Prior to deployment, the application will be configured with the required API endpoints, database connection, authentication settings, **user** roles, token criteria, badge requirements, leaderboard configuration, and reward information. The application will then be installed on compatible mobile devices for student use, while the authorized Professor functions will be made available through the appropriate interface. The deployment will be conducted in a controlled environment to support the proper operation, security, and management of the system and its stored information.

3.6 Testing and Evaluation

The developed Studyforge mobile application will undergo testing and evaluation to verify that its functions operate correctly, that the different system components work together properly, and that the application meets the requirements identified in the study. Testing will focus on the major functions of the system, including user authentication, academic activity recording, token awarding,

token balance updating, badge evaluation, leaderboard updating, reward redemption, and Professor monitoring and management. Testing will be conducted using controlled and authorized test data to identify errors and inconsistencies before the application is deployed for its intended users.

Unit Testing will be conducted to test individual system components separately. Each major module, including user authentication, academic activity management, token management, badge management, leaderboard management, reward redemption, and Professor management, will be tested to determine whether its specific functions produce the expected results. For example, the token management module will be tested to verify whether the correct amount of virtual currency is awarded when a student meets a predefined academic activity criterion. Errors identified during unit testing will be corrected before the affected components are integrated with other parts of the system.

Integration Testing will be performed to verify that the different system components communicate and exchange information correctly. The testing will examine the interaction between the mobile application, backend services, and centralized database. It will also verify connected processes, such as recording an academic activity, applying the token criteria, updating the student's token balance, checking badge requirements, and displaying the updated progress. The reward redemption process will also be tested to ensure that token deductions and redemption records are properly reflected in the database and displayed in the application.

User Acceptance Testing (UAT) will be conducted with selected intended users to determine whether the developed application meets the functional requirements and can be used according to its intended purpose. Students will evaluate functions related to viewing academic activities, monitoring tokens, badges, leaderboard information, and redeeming rewards. Professors

will evaluate functions related to monitoring student activities and managing token criteria and rewards. Feedback from the users will be used to identify usability issues and other improvements needed before final deployment.

The system will also be evaluated using selected characteristics of the ISO/IEC 25010 software quality model, specifically functional suitability, performance efficiency, usability, and reliability. Functional suitability will assess whether the application provides the required functions correctly and completely. Performance efficiency will evaluate the system's response and resource usage while performing its required operations. Usability will assess whether the application is understandable, easy to learn, and easy to operate for its intended users. Reliability will assess whether the application performs consistently and maintains proper operation during its use.

The evaluation will use a 5-point Likert scale to measure the respondents' assessment of the selected software quality characteristics. The collected responses will be summarized using appropriate descriptive statistical measures, such as frequency, percentage, and weighted mean, to determine the evaluation results for each quality characteristic. The results will be used to identify the strengths and areas for improvement of the Studyforge mobile application.

Overall, the testing and evaluation process will ensure that the Studyforge mobile application functions according to its requirements and that its major components operate correctly both individually and as an integrated system. The results of the testing and ISO/IEC 25010-based evaluation will provide measurable evidence of the application's functional suitability, performance efficiency, usability, and reliability before its final implementation.

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