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Mobile-Assisted Learning: Development of a Quiz Application to Support Mastery of Programming Fundamentals in Freshman BSIT Education

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Abstract: With the increasing challenges faced by first-year Bachelor of Science in Information Technology (BSIT) students in understanding programming fundamentals, the need for effective and engaging learning tools has become essential. Many students struggle due to limited hands-on practice and lack of interactive learning resources, which can affect their academic performance and confidence in programming. Traditional teaching methods often fail to provide sufficient engagement and immediate feedback necessary for mastering coding concepts. This study proposes the development and evaluation of a mobile quiz application called *C Quiz Master* to enhance students' understanding of programming concepts. The application offers interactive quizzes integrated with gamified features, including story mode, ranking game mode, user login functionality, and an admin dashboard for managing quiz content and monitoring student performance. The system was developed using the Rapid Application Development (RAD) model, which involves requirements planning, system design, development, testing, and evaluation phases. The application was evaluated by selected first-year BSIT students through a survey questionnaire to assess usability and effectiveness. Results indicate improved student engagement, enhanced reinforcement of programming knowledge, and increased motivation to practice coding. The findings suggest that the mobile quiz application serves as an effective, accessible, and scalable supplementary learning tool for improving programming fundamentals among first-year BSIT students.

Keywords: Mobile Quiz Application, Programming Fundamentals, Gamification, BSIT Students, Interactive Learning Tools, Rapid Application Development (RAD)

I. INTRODUCTION

Programming is one of the most important foundational subjects in the Bachelor of Science in Information Technology (BSIT) program, particularly for first-year students [1]. However, many freshmen encounter difficulties in understanding programming fundamentals such as syntax, logical thinking, and problem-solving [2]. Traditional teaching approaches often rely on lectures and limited hands-on practice, which may not be sufficient for students who are still developing their programming skills [3]. As a result, some students lose motivation and struggle to fully understand basic programming concepts [4]. With the rapid development of mobile technology, mobile-assisted learning has become an effective approach to improving student engagement and learning outcomes [5]. Mobile devices allow students to access learning materials anytime and anywhere, making learning more flexible and accessible [6]. In addition, integrating interactive tools such as quiz-based learning and gamification can make the learning process more engaging and enjoyable [7]. These strategies can help students practice programming concepts more frequently and improve their understanding through continuous assessment and feedback [8]. In response to these challenges, this study focuses on the development of C Quiz Master, a mobile-based quiz application designed to support the mastery of programming fundamentals among first-year BSIT students. The application provides an interactive platform where students can review lessons, answer quizzes, receive instant feedback, and monitor their progress. It also includes gamification features such as story mode and ranking systems to increase student motivation and participation. Furthermore, the study evaluates the effectiveness of the C Quiz Master application in terms of usability, functionality, and learning support. The system aims to help students improve their understanding of programming concepts while making the learning process more interactive and student-centered. Ultimately, this research contributes to the development of innovative mobile-assisted learning tools that support modern education and enhance the learning experience of freshman BSIT students [9].

1. Objectives of the study

- 1.1. Provide an interactive and accessible platform that enables students to practice programming concepts anytime and anywhere;
- 1.2. Enhance student engagement and motivation through gamified features such as story mode and ranking game mode ;
- 1.3. Reinforce understanding of programming fundamentals, including syntax, logic building, and problem-solving skills through structured quizzes ;
- 1.4. Enable efficient management of quiz content and monitoring of student performance through an admin dashboard; and
- 1.5. Promote independent and continuous learning by offering immediate feedback and progress tracking .

2. Determine the usability of the developed application based on the USE Questionnaire in terms of Usefulness, Ease of Use, Ease of Learning, and Satisfaction [10].

3. Evaluate the software quality of the system using the ISO/IEC 25010 software quality model, focusing on characteristics such as functional suitability, usability, performance efficiency, and reliability [11].

II. METHODS

This study utilized a developmental research approach to design, develop, implement, and evaluate a mobile quiz application called C Quiz Master aimed at enhancing programming fundamentals among first-year BSIT students [12]. This approach is appropriate as it focuses on creating and improving an educational tool based on user needs and feedback.

The system was developed and tested among selected first-year Bachelor of Science in Information Technology (BSIT) students at Madridejos Community College. The application was designed to provide interactive and gamified learning experiences to improve students' understanding of programming concepts.

A. System Development Process

The development of the system followed the Waterfall Model, a linear and sequential Software Development Life Cycle (SDLC) approach [13]. In this model, each phase must be completed before proceeding to the next phase. It emphasizes structured planning, proper documentation, and systematic execution of each stage.

The phases involved in the development process are as follows:

1. Requirements Gathering - In this phase, the researchers identified the problems encountered by first-year BSIT students in learning programming fundamentals. Data were gathered through observations and informal interviews, revealing issues such as difficulty in understanding coding concepts, lack of practice, and low engagement. Based on these findings, system requirements were defined, including quiz functionality, user login, progress tracking, and gamification features.

2. **System Design** - The system architecture and interface were planned during this phase. The application was designed to include features such as story mode quizzes, ranking game mode, user authentication, and an admin dashboard. The database structure, user interface layout, and system flow were also created to ensure a smooth and user-friendly experience.
3. **Development** - In this phase, the actual coding and implementation of the system were carried out. The mobile application was developed using appropriate programming tools and frameworks. Key components implemented include the quiz engine, scoring system, leaderboard, user authentication, and admin panel for managing quiz content. The backend system handled data processing, storage, and retrieval.
4. **Testing** - The developed system underwent testing to identify and fix errors and ensure proper functionality. Functional testing was conducted to verify that all features, such as quiz navigation, scoring, and user login, were working correctly. Usability testing was also performed to ensure the application was easy to use and understand for students.
5. **Pilot Implementation** - The system was deployed on a limited group of first-year BSIT students for actual use. During this phase, users interacted with the application by answering quizzes and exploring its features. Feedback was collected regarding usability, performance, and overall experience, which helped evaluate the effectiveness of the system.
6. **Maintenance** - After deployment, the system was continuously monitored and maintained to ensure optimal performance. Necessary updates, bug fixes, and improvements were implemented based on user feedback and observed issues.

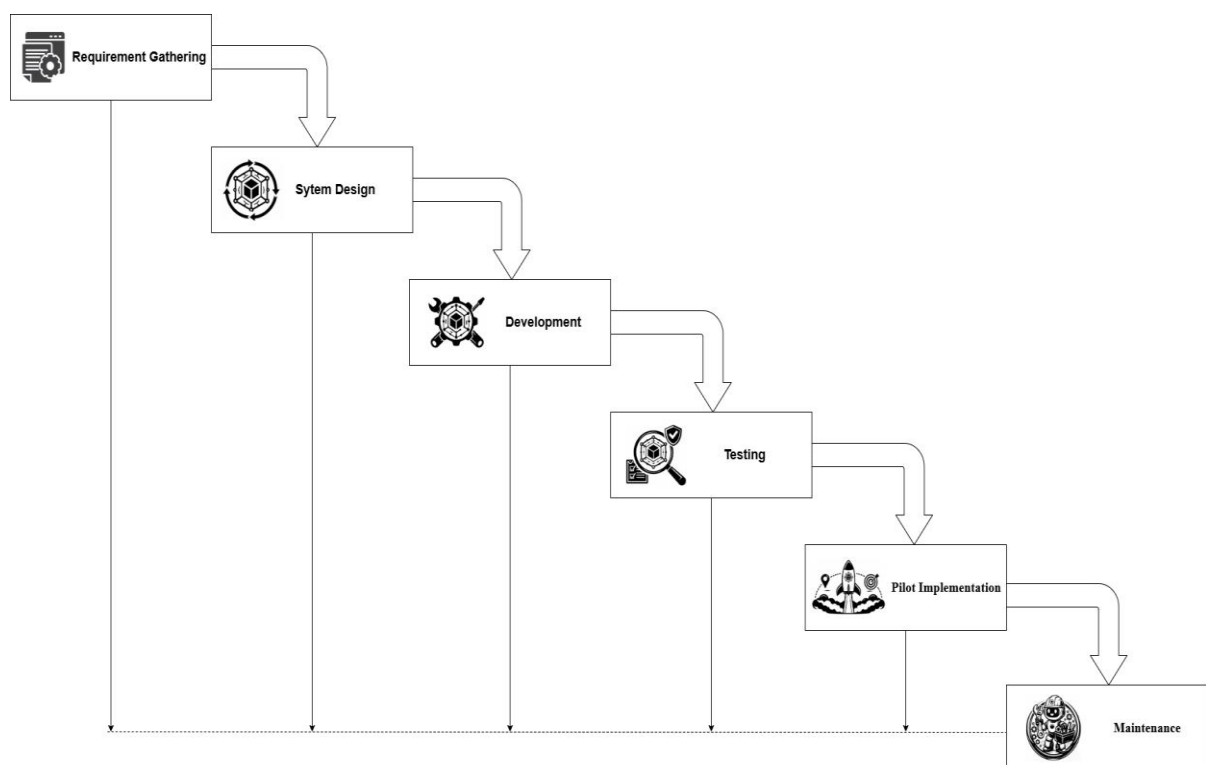


Fig. 1 Waterfall model

The Waterfall Model is one of the earliest methodologies used in system development and follows a structured and sequential process [13]. In this approach, each stage of development must be completed before moving to the next phase, creating a flow that resembles a waterfall. As explained in , the model typically includes several stages such as requirements analysis, system design, implementation, testing, deployment, and maintenance. This method focuses on careful planning, clear documentation, and well-defined objectives at the beginning of the project. Because of its organized structure, it is effective for projects where the requirements are already clear and stable. However, it is less adaptable to modifications during development since returning to previous stages can be difficult and costly. Compared with iterative approaches such as Agile development, the Waterfall Model assumes that most decisions are finalized early in the process.

B. System Architecture

The overall structure of the system is illustrated in **Figure 2**. The architecture consists of users, system modules, backend server, and database components.

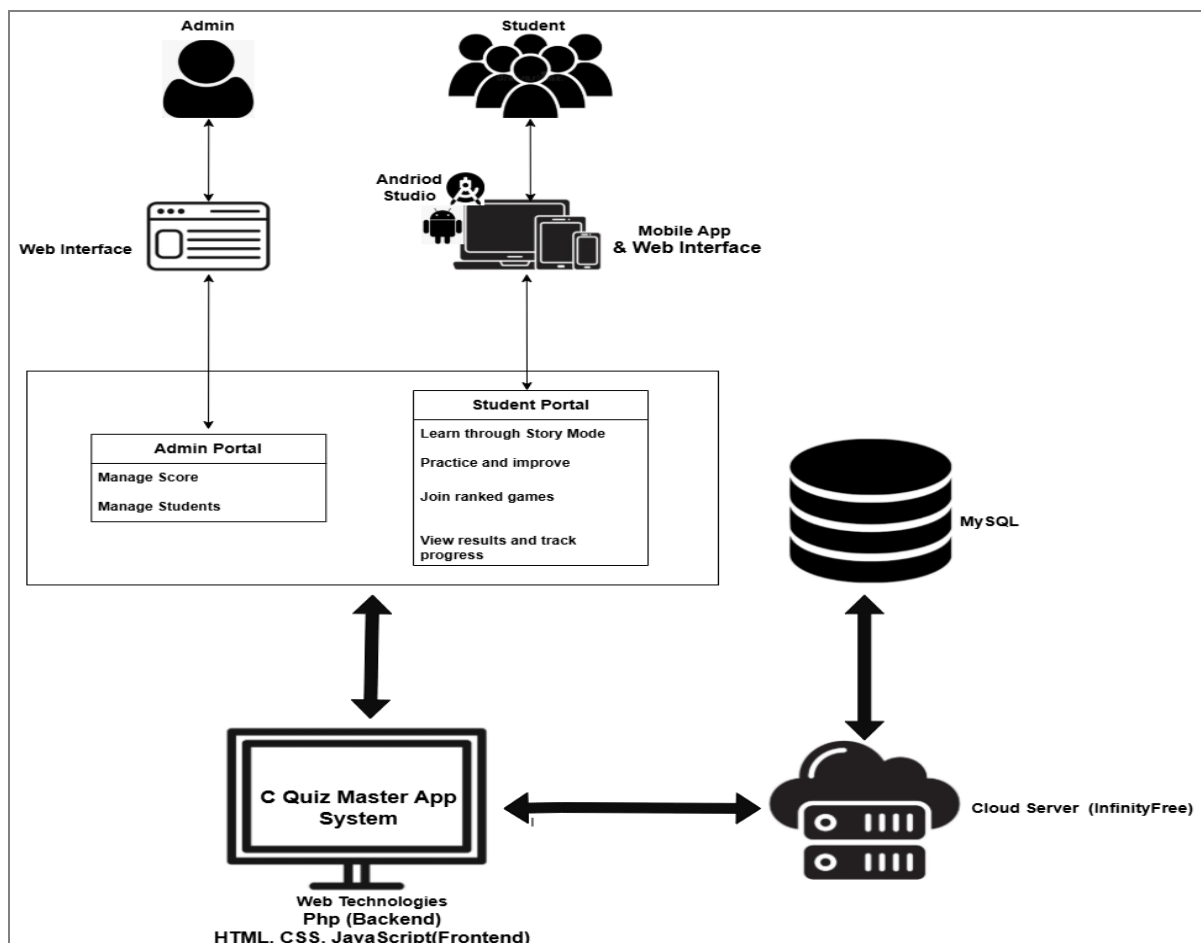


Figure 2. System Architecture of C Quiz Master

The system allows students to access quizzes through a mobile interface. They can answer questions, receive instant feedback, and track their progress. The application includes different modules such as quiz management, scoring system, and ranking system. An admin module enables administrators to manage quiz content, monitor student performance, and update questions through a web interface. The system communicates with a backend server that processes requests, evaluates answers, and stores results in a database. When a student completes a quiz, the system automatically calculates scores and displays results in real time. This architecture ensures efficient data flow, real-time feedback, and an interactive learning experience for users.

C. System Performance

Overall, the study demonstrates that *C Quiz Master* is a functional and efficient mobile quiz application capable of supporting the learning needs of first-year BSIT students in programming fundamentals. The system successfully performed core functions such as user authentication, quiz delivery, score computation, and data storage. During testing, the application showed fast response time, with quiz questions loading quickly and results being displayed immediately after submission. The scoring mechanism accurately evaluated answers, ensuring consistency and reliability. The system also effectively stored user progress, scores, and rankings in the database without data loss or duplication. From the student perspective, the application was easy to use and accessible. Users were able to navigate between different features such as story mode and ranking mode with minimal difficulty. The gamification elements, including leaderboards and progress tracking, increased user engagement and encouraged continuous practice. From the administrator perspective, the admin interface provided efficient control over the system. Administrators were able to manage quiz questions, monitor student performance, and update content through a web-based dashboard. This feature ensured that the system remained dynamic, organized, and adaptable to learning needs. Furthermore, the system promoted active and self-paced learning, allowing students to practice programming concepts anytime and anywhere. This contributed to improved understanding of fundamental topics such as syntax, logic building, and problem-solving. Overall, the

implementation of *C Quiz Master* resulted in an interactive, reliable, and user-friendly learning tool. The system effectively supports both learners and administrators, making it a practical solution for enhancing programming education.

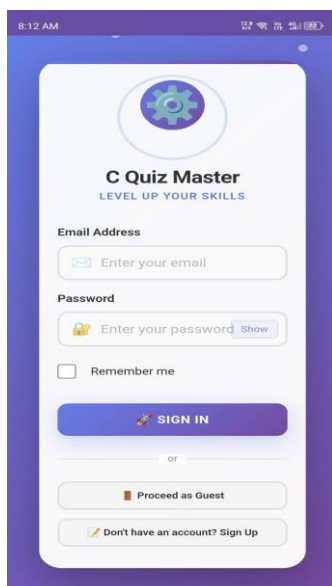


Fig. 3 Login Page

Figure 3 shows the login screen of the C Quiz Master application, designed with a clean interface and a purple background. It includes fields for the user's email address and password, a "Remember me" option, and a Sign In button for registered users. It also provides options to Proceed as a Guest or Sign Up, allowing students to access or create an account to start learning and practicing C programming through quizzes.

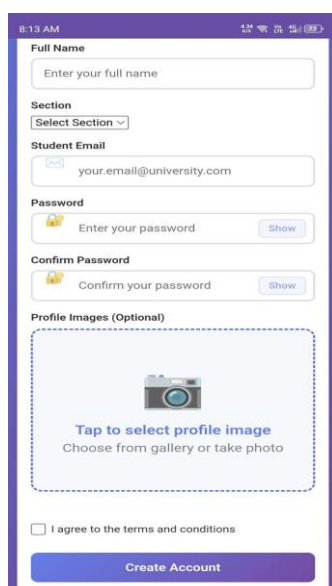


Fig. 4 Sign-Up Page

Figure 4 shows the account registration screen where new users can create an account in the C Quiz Master application. The form requires users to enter their full name, select their section, provide a student email, create and confirm a password, and optionally upload a profile image. Users must also agree to the terms and conditions before clicking the Create Account button to register in the system.

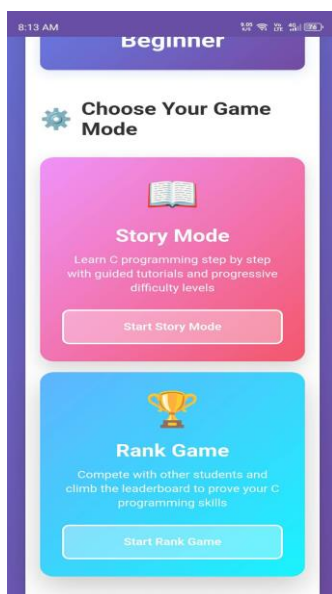


Fig. 5 Main Menu Interface

Figure 5 shows the Game Mode Selection screen in the C Quiz Master application. In this interface, users can choose how they want to learn and play. The screen presents two options: Story Mode and Rank Mode. Story Mode is designed for learning C programming concepts step-by-step. In this mode, students can read lessons and study programming topics. At the bottom of the Story Mode, users can proceed to the quiz section to test their understanding of the lesson. After completing the quiz, the results are recorded and reflected in the Rank Mode leaderboard. Rank Mode allows users to compete with other players based on their quiz scores, encouraging students to improve their performance and enhance their programming skills. This feature makes the learning experience more interactive, engaging, and competitive for students.



Fig. 6 Story Mode Interface

Figure 6 shows the Story Mode – Learn C Programming screen in the C Quiz Master application. This interface allows users to study C programming topics in an organized and easy-to-follow format. Each lesson is presented in a card layout, such as Introduction to C Programming and C Syntax Discussion, where users can read explanations about programming concepts, characteristics, and examples. The "Read Discussion" button allows users to open and view the full lesson content. After reading the discussion, users can proceed to the quiz section located at the bottom of the lesson to test their understanding. This feature helps students learn step-by-step before moving to the quiz, making the learning process more structured, interactive, and effective.

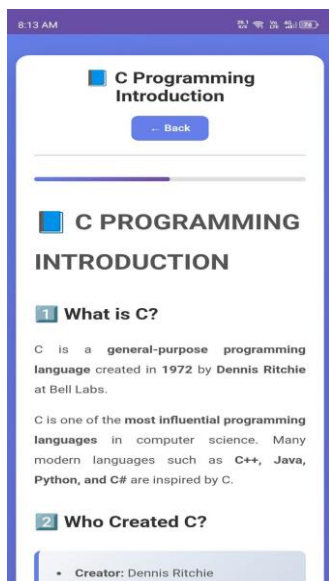


Fig. 7 Story Mode Discussion

Figure 7 shows the C Programming Introduction discussion screen in the C Quiz Master application. This interface displays the learning content for the selected topic in Story Mode. The screen includes the lesson title, progress indicator, and detailed explanations such as "What is C?" and "Who Created C?". The content provides students with foundational knowledge about C programming, including its purpose, importance, and background. Users can scroll through the page to read the full discussion and understand the concepts before proceeding to the quiz section. This feature supports step-by-step learning and helps students build a strong foundation in C programming before taking assessments.

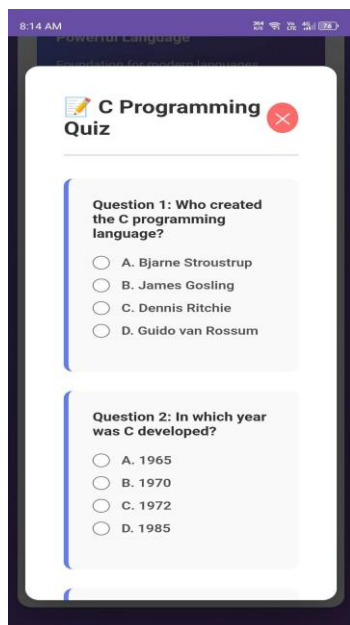


Fig. 8 Story Mode Quiz

Figure 8 shows the quiz section in the C Quiz Master application under Story Mode. This interface allows users to answer multiple-choice questions based on the lesson they have studied. The screen presents the question along with several answer choices, enabling students to select the correct answer. This quiz appears after the discussion section to evaluate the user's understanding of the C programming topic. Once completed, the user's score is recorded and may be reflected in the Rank Mode leaderboard. This feature helps reinforce learning, assess knowledge, and encourage students to improve their programming skills through interactive assessment.

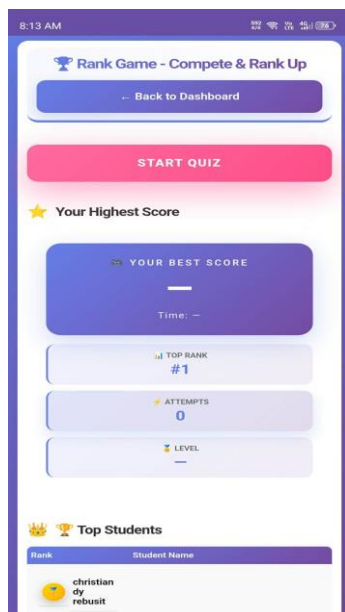


Fig. 9 Rank Game Interface

Figure 9 shows the Rank Mode screen of the *C Quiz Master* application. The interface includes a Start Quiz button, the user’s highest score, best score, rank position, number of attempts, and level. It also displays a Top Students leaderboard, allowing users to compare their performance with other players.

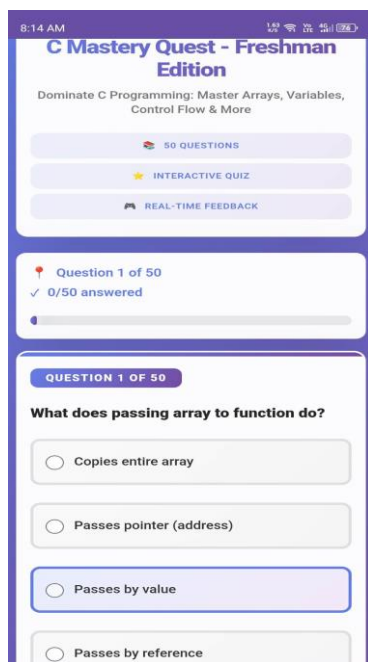


Fig. 10 Rank Mode – Quiz Interface

Figure 10 shows the quiz screen in Rank Mode of the *C Quiz Master* application. The interface displays the quiz title, number of questions, and progress indicator. It also presents a multiple-choice question with several answer options, allowing users to select the correct answer while tracking their progress in the quiz.

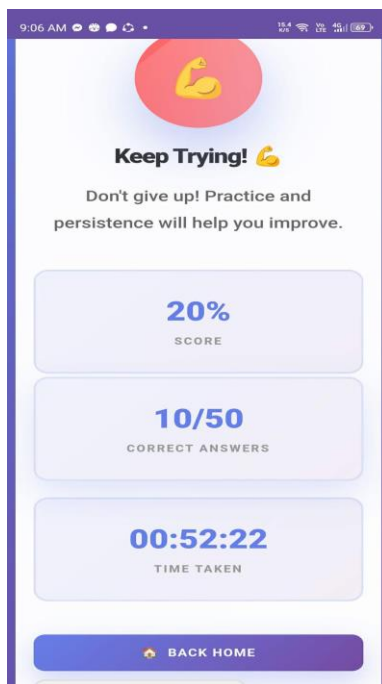


Fig. 11 Quiz Result Interface

Figure 11 shows the quiz result screen of the *C Quiz Master* application. The interface displays a motivational message, the user’s score percentage, number of correct answers, and the total time taken to complete the quiz. It also includes a Back Home button that allows users to return to the main menu after viewing their results.

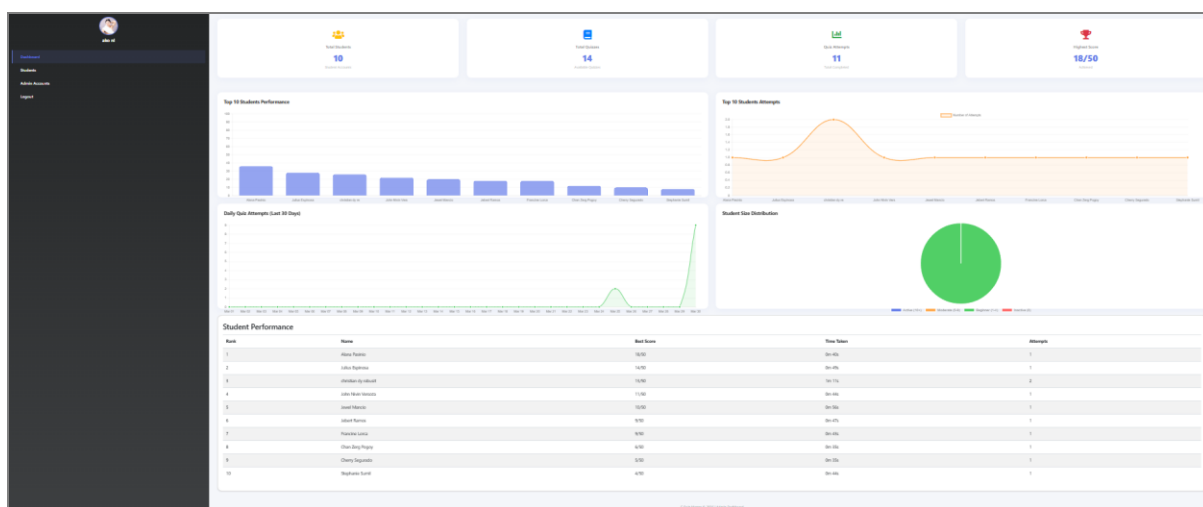


Fig. 12 Admin Dashboard Interface

Figure 12 shows the admin dashboard of the *C Quiz Master* application. The interface displays summary statistics such as total users, quiz attempts, and overall performance. It also includes charts and graphs for quiz scores and student activity, along with a table showing detailed student performance records.

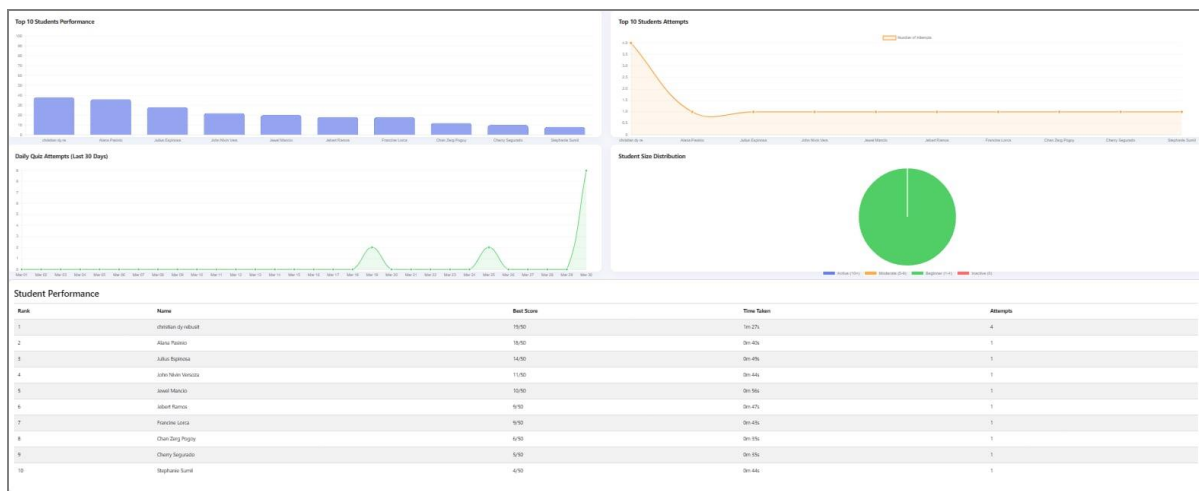


Fig. 13 Admin Dashboard Interface

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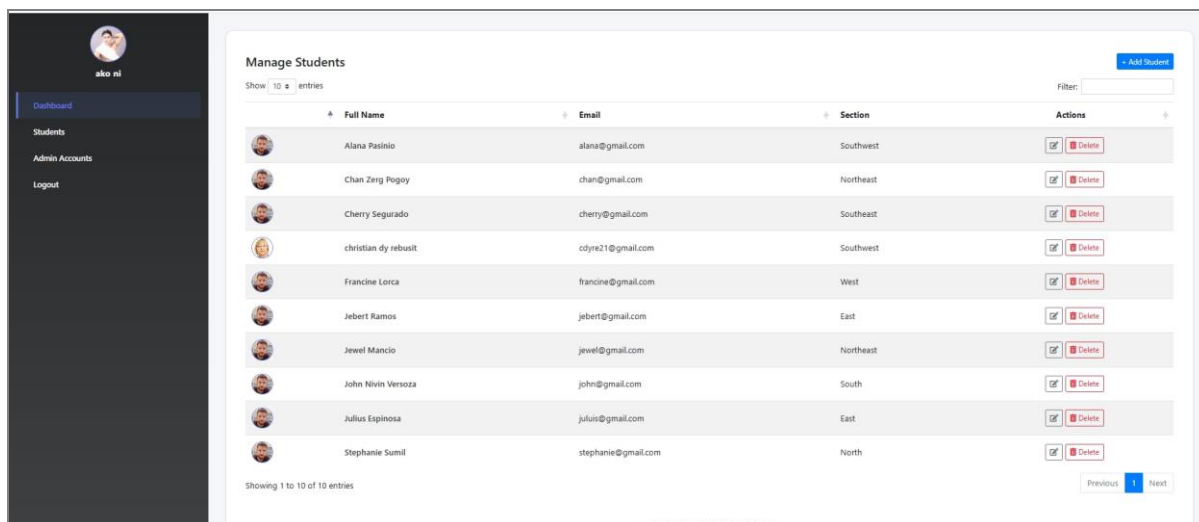


Fig. 14 Manage Students Interface

Figure 14 shows the Manage Students screen in the *C Quiz Master* admin dashboard. The interface displays a list of registered students, including their names, email addresses, and assigned sections. It also provides action buttons that allow the administrator to edit or delete student accounts.

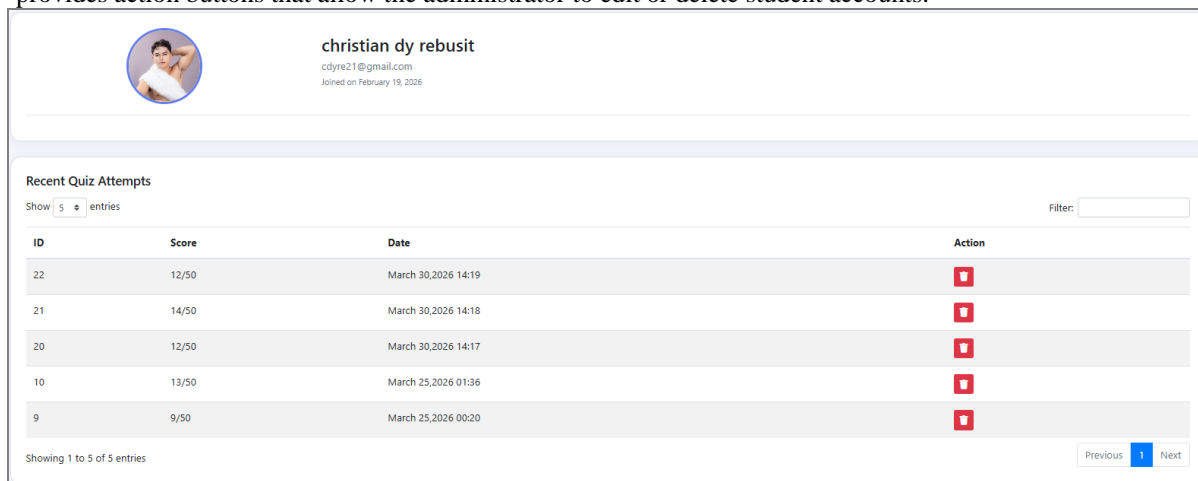


Fig. 15 Student Profile and Quiz Attempt Records

Figure 15 shows the student profile screen in the *C Quiz Master* admin dashboard. The interface displays the student's profile information along with a table of recent quiz attempts, including the quiz score, date, and action buttons for managing the records.

Data Gathering Procedure

Data were collected using standardized questionnaires, specifically the Usefulness, Satisfaction, and Ease of Use (USE) Questionnaire [10] and the ISO/IEC 25010 Software Quality Model [11]. In addition, a set of objective functionality questions was developed to evaluate the effectiveness of the *C Quiz Master* mobile application in enhancing programming fundamentals among first-year BSIT students. The respondents of the study consisted of thirty (30) first-year BSIT students from Madridejos Community College and three (3) instructors/IT experts, with a total of thirty-three (33) respondents. These participants were selected to evaluate the system in terms of usability, functionality, and software quality. A structured questionnaire was distributed to the selected respondents after they interacted with the application. The collected data were analyzed and consolidated and were used as the basis for evaluating the system's performance and effectiveness.

III. RESULTS AND DISCUSSION

The study focuses on the creation and testing of **C Quiz Master**, a mobile quiz app designed to help first-year BSIT students improve their programming fundamentals. The app allows students to take quizzes anytime on their phones, receive instant feedback, and track their progress. It also includes game-like features such as story mode, rankings, and score tracking to make learning more engaging. Testing showed that the system works reliably, evaluates answers accurately, and responds quickly when loading questions and showing results. Students found the app easy to use and more enjoyable than traditional learning methods. The gamification features encouraged them to practice more often, which helped them better understand programming concepts like syntax, logic, and problem-solving. Overall, the study concludes that *C Quiz Master* is an effective support tool for programming education because it increases student engagement, promotes continuous practice, and makes learning more interactive and accessible.

TABLE I
Likert Scale interpretation

Scale	Value	Verbal Interpretation
Strongly Agree	5	4.21-5.00
Agree	4	3.41-4.20
Neutral	3	2.61-3.40
Disagree	2	1.81-2.60
Strongly Disagree	1	1.00-1.80

The study used a five-point Likert scale to measure the responses of the participants regarding the usability, effectiveness, and functionality of the *C Quiz Master* mobile application. The Likert scale is commonly used in educational research to evaluate attitudes, perceptions, and user satisfaction. Each response was assigned a numerical value ranging from 1 to 5, where 5 represents *Strongly Agree* and 1 represents *Strongly Disagree*. The weighted mean of the responses was computed to determine the overall evaluation of the system. The computed mean scores were then interpreted using the Likert Scale Interpretation Table. A mean score ranging from 4.21 to 5.00 indicates that the respondents strongly agree with the given statement, while a mean score ranging from 3.41 to 4.20 indicates agreement. Scores between 2.61 and 3.40 represent a neutral response, while scores between 1.81 and 2.60 and 1.00 to 1.80 indicate disagreement and strong disagreement, respectively. This interpretation method allowed the researchers to clearly analyze the responses of the students and determine the overall effectiveness, usability, and acceptability of the *C Quiz Master* application.

TABLE II
Descriptive Functionality Evaluation

	Mean	Interpretation
Provides an accessible platform for practicing programming concepts	4.21	Strongly Agree
Increases engagement through gamified features	4.17	Agree
Strengthens programming fundamentals via quizzes	4.26	Strongly Agree
Supports quiz management and performance monitoring	4.33	Strongly Agree
Encourages independent learning with feedback and tracking	4.18	Agree
Overall Mean	4.23	Strongly Agree

Table 1 presents the computed mean scores based on the responses of 33 respondents (30 students and 3 instructors/IT experts) using a 5-point Likert scale (5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree) .

TABLE III
USE Questionnaire Results

Criteria	Mean	Interpretation
Usefulness	4.20	Agree
Ease of Use	4.21	Strongly Agree
Ease of Learning	4.23	Strongly Agree
Satisfaction	4.35	Strongly Agree
Overall Mean	4.25	Strongly Agree

Table 2 shows the results of the USE Questionnaire, which evaluates the system's usability in terms of usefulness, ease of use, ease of learning, and user satisfaction. The overall mean reflects the perceived usability of the *C Quiz Master* application.

TABLE IV
ISO/IEC 25010 Software Quality Evaluation

Criteria	Mean	Interpretation
Functional Suitability	4.67	Strongly Agree
Performance Efficiency	4.33	Strongly Agree
Compatibility	4.63	Strongly Agree
Reliability	4.50	Strongly Agree
Security	4.11	Agree
Overall Mean	4.45	Strongly Agree

Table 3 presents the evaluation results based on the ISO/IEC 25010 software quality model. The data were gathered from 33 respondents to assess the overall quality of the mobile quiz application.

IV. CONCLUSIONS

This study successfully addressed the challenges faced by first-year BSIT students in mastering programming fundamentals, including limited practice opportunities, low engagement, and difficulty in understanding core concepts. By developing and implementing the *C Quiz Master* mobile application, the study provided an interactive, accessible, and gamified learning tool that enhances students' learning experience beyond traditional classroom methods. The system demonstrated that mobile-based quiz applications can effectively support continuous learning by allowing students to practice programming concepts anytime and anywhere. Features such as story mode quizzes, ranking systems, and instant feedback contributed to increased student motivation, engagement, and participation. The application enabled users to identify their mistakes in real time, reinforcing their understanding of key topics such as syntax, logic building, and problem-solving. Evaluation results indicated that the system performed reliably in terms of functionality, usability, and efficiency. Students were able to navigate the application easily, complete quizzes without difficulty, and benefit from immediate feedback. The inclusion of gamification elements encouraged repeated use and fostered a more engaging and enjoyable learning environment. Additionally, the admin module provided instructors with the ability to manage content and monitor student performance effectively. The findings confirm that *C Quiz Master* is a viable and

effective supplementary learning tool for programming education. It promotes active learning, supports self-paced study, and enhances students' mastery of programming fundamentals. Compared to traditional teaching methods, the system offers improved accessibility, real-time feedback, and data-driven insights into student performance. In conclusion, the developed mobile quiz application provides a practical and scalable solution for improving programming education among first-year BSIT students. It contributes to the integration of digital learning technologies in higher education and supports the development of more engaging and student-centered learning environments. Future enhancements of the system may include the addition of more advanced quiz levels, integration of multimedia learning content, offline functionality, and analytics features for deeper performance evaluation. Expanding the application to support other programming subjects and courses may further increase its impact and usability. Overall, this study demonstrates the potential of mobile and gamified learning tools in enhancing academic performance and fostering a deeper understanding of programming concepts among students.

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APPENDIX



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