The Design and Development of an Android Application for Elementary Schools Based on QR Code

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Abstract. *The rapid development of digital technologies has stimulated the integration of mobile learning to promote more efficient and flexible learning processes. However, teaching activities are still dominated by traditional methods with limited access to digital resources, which makes it difficult for students, especially in elementary schools, to access their learning. Therefore, this research aims to design and develop a mobile education application based on Android and integrated with the QR code technology called EduQR, to allow students to access their educational material quickly and easily. The research method included observations and literature studies followed by analysis of the system, development of applications, implementation and testing. The application has been developed with Android Studio using the Java programming language and uses the QR code scanner to connect students directly to digital learning materials that are stored online. The proposed application offers key features such as scanning of the QR code to access the educational material, learning history and management of user profiles. The results show that EduQR works correctly, is user-friendly and effectively supports students in gaining access to the digital learning resources, with hopes this will lead to increase their digital literacy, supporting independent learning and helping teachers to deliver materials in a more practical and interactive way.*

Keywords: *Mobile Application, Learning Media, QR Code, Android*

1. Introduction

The development of digital technology has brought significant changes in various aspects of life, including in the field of education. The use of digital technology in the learning process is considered to be able to increase the effectiveness, flexibility, and engagement of students (Said, 2023). One form of technology application that is rapidly developing is mobile learning, which utilizes mobile devices such as smartphones and tablets to support the learning process anytime and anywhere (Helen Crompton, Diane Burke, 2017). The use of this technology is expected to improve the effectiveness and quality of learning, especially at the elementary school level.

At the elementary school level, the use of digital technology as a learning medium still presents pedagogical challenges, particularly in supporting students' independent learning outside classroom activities. Learning activities generally still rely on printed books and direct explanations from teachers, which limits students' access to additional learning materials outside class hours and hinders them from reviewing or deepening their understanding of the material (Wahyudi & Jatun, 2024). Therefore, appropriate and easy-to-use digital learning media are needed to support more effective and engaging learning for elementary school students (Zahwa & Syafi'i, 2022). In addition, the limitations of simple and easy-to-use digital media have prevented the optimal integration of technology in elementary school environments.

Along with technological developments, the use of Quick Response (QR) Codes has begun to be widely applied in the world of education. QR Codes are a technology capable of storing information and connecting users directly to digital content simply by scanning them using a mobile device camera (Hamdani et al., 2024). Several studies show that the integration of QR Codes in learning can increase learning motivation, ease of access to materials, and student engagement in the learning process (Zahrah & Wardhana, 2025). QR Codes are also considered suitable for elementary school students because their use is simple and does not require complex technical skills.

The use of QR Codes in learning is generally supported by mobile applications. Mobile applications are software that are designed to run on mobile devices such as smartphones and tablets to support user needs (Hernando & Macías, 2023). Android is one of the most widely used platforms for mobile application development, providing a Software Development Kit (SDK) and Application Programming Interface (API) to support application development using the Java programming language. Android applications are packaged in .apk file format and can be installed on mobile devices, making the platform flexible and accessible for developing learning applications.

Based on previous literature reviews and research, many Android-based learning media and QR Code technologies have been developed with the aim of improving learning outcomes and motivation among elementary school students. Various studies show that the use of digital technology in learning has significant potential. A summary of previous studies relevant to this study is presented in Table 1.

Table 1. Summary of previous studies

Researcher & Year	Media Type	Focus Material	Research Results	Shortcomings
(Prana Dwija Iswara, J. Julia, Tedi Supriyadi, 2023)	Android-based learning	Early reading skills (elementary school)	Valid and effective media for improving reading skills	Limited to early reading skills
(Aisyah, 2025)	QR Code-based Light Properties House media	IPAS	Improves student's learning outcomes	Limited further development
(Nashrudin & Jadmiko, 2025)	QR Code-based Rotating Wheel Learning Media	plane geometric angles	QR Code–based rotating wheel media helped students understand plane angle concepts through videos.	The QR Code only functioned as a video link

From the above table, it can be concluded that previous studies generally focused on the development of Android-based or QR Code-based learning media for specific materials. However, most of the media developed are still limited to one learning function and do not provide an integrated learning system that allows quick, structured access to materials and records student learning activities.

Based on these problems, an innovative solution is needed in the form of an Android-based learning application integrated with QR Code technology. This study aims to design and develop an Android-based learning application integrated with QR Code technology (EduQR) to facilitate elementary school students in accessing learning materials quickly and independently. This study is limited to the design, development and

testing of the functionality and usability of the EduQR application in the environment of the Indonesian School in Kuala Lumpur, without covering implementation on a large scale.

2.   Method

This section describes the research methodology used in the development of the EduQR application. The method is structured to ensure a systematic and comprehensive approach, covering the research flow, data collection techniques, and system design. The methodological framework aims to support the development of an Android-based mobile learning application integrated with QR Code technology that meets user needs and functions effectively in an elementary education context.

2.1   Research Flow

The development of a QR Code-based educational mobile application follows a systematic research process, including needs analysis, literature study, system design, implementation, testing, and evaluation Figure 1.
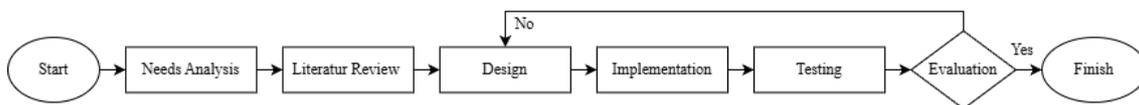

Figure 1. Research flowchart

The EduQR application development stage began with a needs analysis to determine key features such as a dashboard, QR Code scanning, learning history, and user profiles. This was followed by a literature study reviewing previous research related to mobile learning, QR Codes, digital learning, and UI/UX principles for children to ensure that the application design was relevant and easy to use. Based on these results, system design was carried out, covering application architecture, QR code scanning flow, and menu and navigation structure. The implementation stage was carried out using Android Studio, the Java programming language, and the ZXing library to support the QR code scanning feature. Finally, testing was conducted covering the functionality, usability, and performance of the application on various Android devices, involving students and teachers as the end-users.

2.2   Research methods

Data collection was performed through observation and literature from previous studies, including journals, books related to mobile learning, QR codes and Android-based learning media. Observation was carried out by observing the learning process at one of the Indonesian schools abroad to determine the needs of students and teachers for digital learning media.

2.3   System Design

The EduQR system outlines the overall workflow, user interactions, and supporting components, organized systematically to meet user requirements. The following subsections describe key aspects of the system, including the Use Case diagram, the proposed system flowchart, and the Entity Relationship Diagram (ERD), to illustrate how the application operates and manages data effectively.

2.3.1 Use Case Diagram

This use case diagram shows the interaction between the admin and students. In the system, the admin is responsible for managing learning materials and generating QR Codes for each content item. To address the limited capacity of the library, a touchscreen interface has been proposed to facilitate students in searching for specific learning materials. Each material displayed on the touchscreen is associated with a unique QR Code, and students can use their mobile device and use the propose application to interact with the system by scanning the QR Codes to access the corresponding learning materials, reviewing their learning history, and tracking their progress.
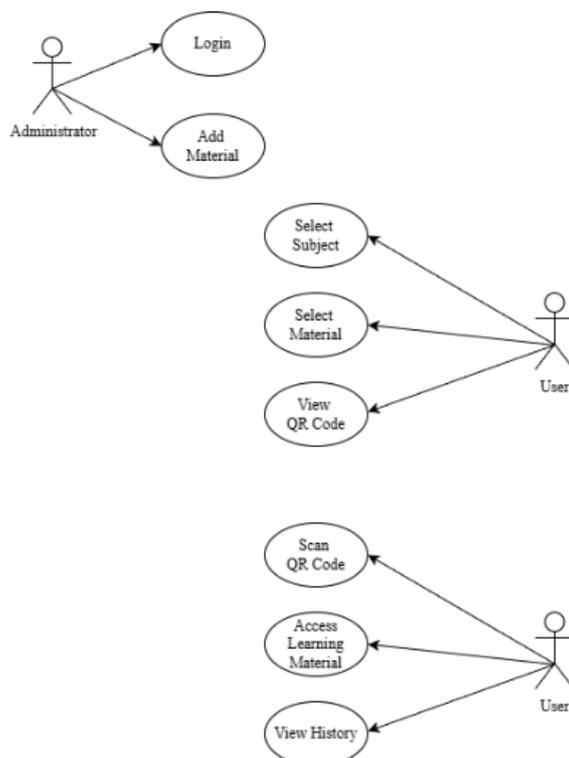
Figure 2. Use case diagram

Figure 3. Touchscreen

The system interactions are illustrated in the use case diagram, Figure 2, highlighting the roles of both the admin and the students. Additionally, a schematic of the touchscreen interface is displayed in Figure 3 to show how learning materials are displayed and how students can scan QR Codes to retrieve the full content.

2.3.2 Proposed System Flowchart

The proposed system flow map illustrates the overall workflow of the application, from user interaction to system processing. It described the interactions between the Admin, System, and Students, including login verification, material management, QR Code generation, and the recording and display of students' learning activity history. This flow visualization helps clarify the application process and supports the technical implementation design. The proposed EduQR system flow map is presented in Figure 4.
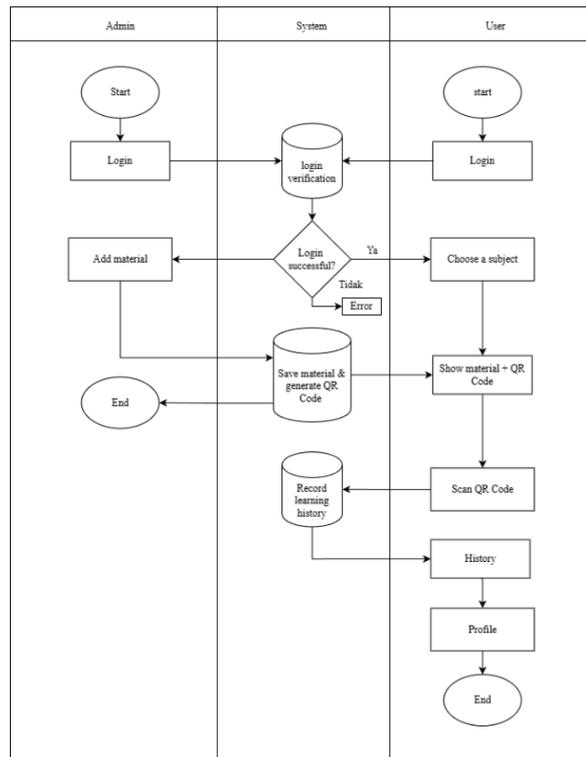
Figure 4. Proposed system flow map

This proposed system diagram makes it possible to understand clearly and structurally the interaction between administrators, systems and students. This diagram will thus become an important reference when developing and implementing EduQR, and will ensure that each function runs in accordance with the system goals.

2.3.3 Entity Relationship Diagram (ERD) Design

This Entity Relationship Diagram (ERD) was created to visualize the database structure and relationships between tables in the EduQR system. The diagram depicts three main entities, namely Students, Materials, and History, along with their attributes and the relationships that connect student activities with the materials accessed, as shown in Figure 5.
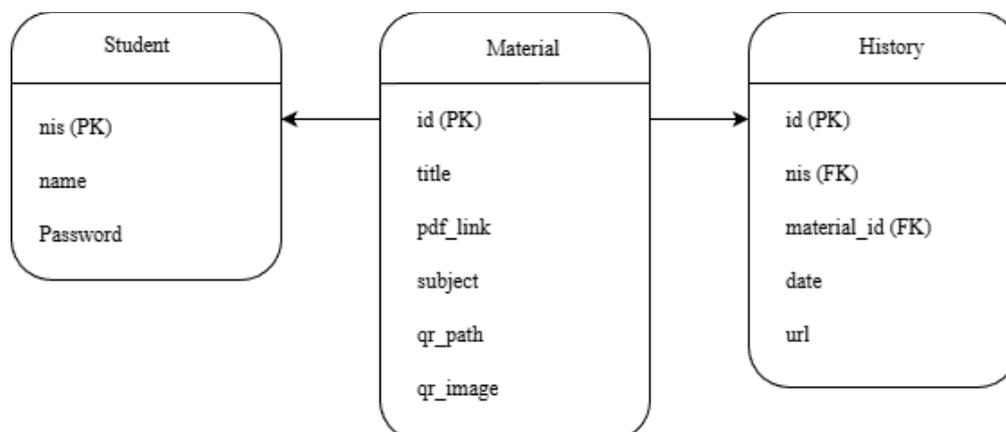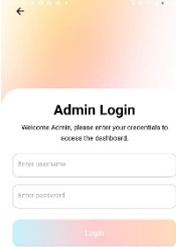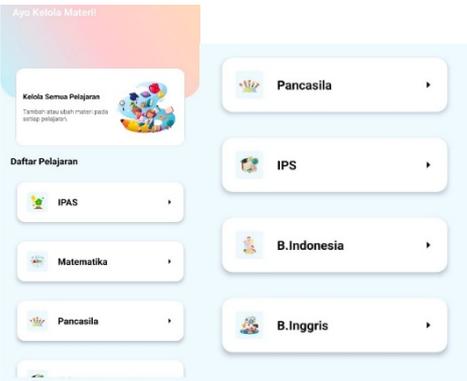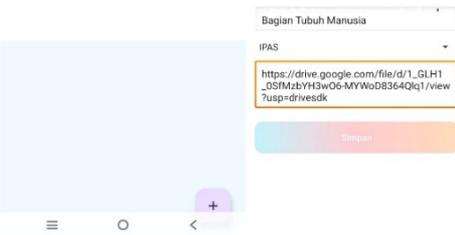

Figure 5. Entity Relationship Diagram (ERD) design

3.   Results and Discussions

The implementation of the EduQR application demonstrates the successful integration of user interface design and system functionality that fulfilled the needs of administrators and students. This application was developed to facilitate access to learning materials through QR code scanning, with support for various subjects and learning formats in the form of text, images, and videos. The application design process emphasized ease of use, clarity of display, and simplicity of interface, so that all users can interact with the system effectively and efficiently.
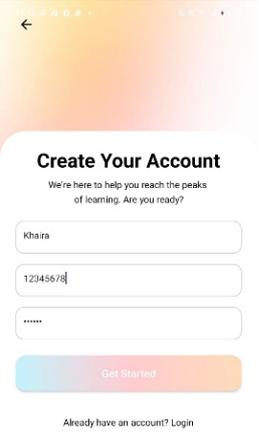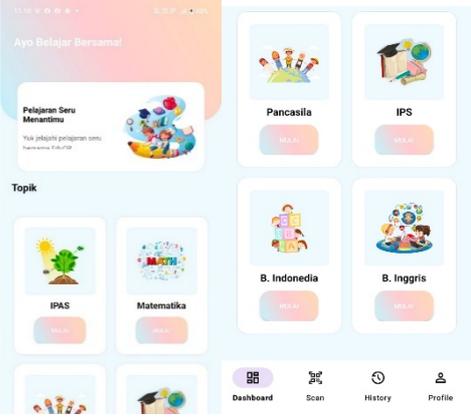
On the administrator side, the login interface provides a secure access mechanism through an authentication process using a username and password. After a successful verification process, administrators are directed to the home page, which functions as the system management centre, including subject and learning material settings. Functional testing shows that all navigation elements on the home page work well. The add material page allows administrators to upload new learning materials by selecting the appropriate subject and entering complete material data. The description of the administrator interfaces and their respective functions is summarized in Table 2.
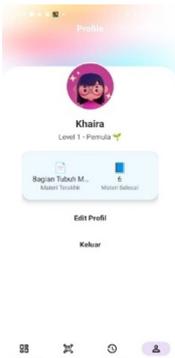
Table 2. Description of Administrator Interfaces in the EduQR Application

No.	Interface	Figure	Description
1	Admin login page		Displays the administrator authentication interface for accessing the system.
2	Admin home page		Presents the main administrator page as the central interface for managing subjects and learning materials.
3	Add material page		Displays the interface for adding new learning materials based on the selected subject.

From the student's perspective, this application provides a number of main interfaces that support the authentication process, access to learning materials, QR code scanning, and monitoring of learning activities. Each interface has been functionally tested to ensure system stability, ease of navigation, and accuracy of material access. A summary of the student interface description and its main functions is presented in Table 3.

Table 3. Description of Student Interfaces in the EduQR Application

No.	Interface	Figure	Description
1	Student login page		Displays the student authentication interface requiring name, student identification number (NIS), and password.
2	Student home page		Presents subjects in the form of interactive cards that direct users to the corresponding material pages.
3	Material page		Displays a list of learning materials based on the subject selected by the student.

No.	Interface	Figure	Description
4	QR scan page		Provides a QR code scanning feature to access learning materials directly.
5	History page		Displays the record of student learning activities based on QR code scanning.
6	Profile page		Displays basic student account information and learning progress.

Based on the implementation presented in Tables 2 and 3, the test result demonstrated that all the core features, such as user authentication, material access, QR code scanning, and learning history recording, operated smoothly without system errors, delays, or functional failures. The EduQR application overall offers several advantages that allow students to quickly access learning materials without manually typing links or conducting independent searches, thereby reducing the potential for input errors and increasing time efficiency. Furthermore, the integration of multimedia content in the form of text and video enriches the learning experience and accommodates diverse student learning methods.

Overall, the proposed solution of the EduQR application has successfully achieved its objectives of offering practicality, efficiency, and ease of use. The whole interfaces operate reliably, supporting core functions, materials management, learning access, QR code scanning, and learning history monitoring.

4. Conclusions

Based on the results, it can be concluded that the Android-based educational mobile application utilizing QR codes has successfully developed and functions in accordance

with the research objectives. This application is able to facilitate quick, practical, and flexible access to learning materials, especially for elementary students. The use of EduQR as a medium for accessing learning materials makes it easy for students to obtain materials without having to go through a complicated process. The application also has a positive impact on the learning process by encouraging students to be more independent and also for teachers to create more attractive learning materials.

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