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# DATA-BUDDY: A GAMIFIED MOBILE LEARNING APP FOR INTERACTIVE STUDENT ENGAGEMENT IN DATA MINING EDUCATION

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## ABSTRACT

*The rapid advancement of technology in education has demanded innovative teaching and learning approaches to enhance student engagement and comprehension. This project introduces a Gamified Mobile Learning App designed to support students in mastering Data Mining concepts through interactive and engaging learning experiences. The primary objective is to provide an accessible, structured, and gamified learning environment that fosters active participation, motivation, and self-paced learning among students. The app integrates video education, quizzes, progress tracking, and gamification elements such as limited attempts and leaderboard rankings to encourage student participation and competitive learning. Developed as a Progressive Web Application (PWA), it ensures cross-platform accessibility on both desktop and mobile devices without requiring installation. The methodology involves designing an intuitive e-learning interface, implementing automated assessment with a three-attempt limit, and integrating Google authentication for seamless user access. The system stores student scores and attempts in a database, allowing for performance analysis and the implementation of adaptive learning strategies. The implementation results indicate increased student engagement, improved quiz completion rates, and enhanced understanding of Data Mining concepts. The mobile-first approach ensures flexibility and accessibility, allowing students to learn at their convenience while maintaining structured academic progress. This innovation contributes to the digital transformation of education by providing a scalable, gamified learning platform that enhances knowledge retention and self-directed learning. Future enhancements may include adaptive learning pathways, AI-based tutoring, and expanded course modules to personalize the learning experience further.*

***Keywords:*** *Mobile Application, Gamification, Data Mining, Progressive Web Application, e Learning*

## INTRODUCTION

Active learning in higher education has gained significant attention as an approach to enhance student engagement and learning outcomes. It involves student participation beyond passive listening, encompassing various techniques like flipped classrooms, team-based learning, and problem-based

learning (Abio Roig & Stoyanova, 2018). As technology continues to shape modern education, the need for tools that support flexible, engaging, and independent learning grows rapidly. Traditional lecture-based delivery often lacks post-class reinforcement, resulting in reduced content retention (Lüscher et al., 2024). Data-Buddy was conceptualized to address these gaps by serving as a dual-purpose teaching and learning tool, both inside and outside the classroom. Its primary objective is to assist students in revising course content after class through an engaging, gamified experience that includes short educational videos and interactive quizzes. Developed as a Progressive Web Application (PWA), Data-Buddy operates directly from any web browser without requiring installation or downloads from the Google Play Store or Apple App Store. This approach simplifies access, reduces storage usage, and eliminates additional costs for students. Functioning like a native mobile app, Data-Buddy can be added directly to a user's home screen, offering a seamless and app-like experience without the need for marketplace publishing. This makes it a free, cost-effective, and low-barrier solution for students and institutions alike. In the classroom, lecturers can use the app for formative assessment, group-based quiz activities, or performance tracking. Outside the classroom, students can review learning materials, track their progress, and participate in leaderboard-based motivation. The integration of Padlet further enhances interactivity by supporting collaborative discussions and feedback. Overall, Data-Buddy is designed to improve learning outcomes through structured, student-centered digital experiences that are accessible, scalable, and highly engaging.

## METHODS

Data-Buddy was developed following the System Development Life Cycle (SDLC). This development includes planning, analysis, design, development, testing, and evaluation. This model allowed for continuous feedback and iterative improvements based on user experience. During the planning and analysis stages, the team identified the needs of students and educators, focusing on enhancing after-class engagement through digital tools. In the design phase, key system components such as the student dashboard, instructional video viewer, quiz module, leaderboard, and carry mark tracker were conceptualized. The development phase involved building the frontend using HTML and CSS, while Flask (Python) served as the backend framework with a MySQL database.

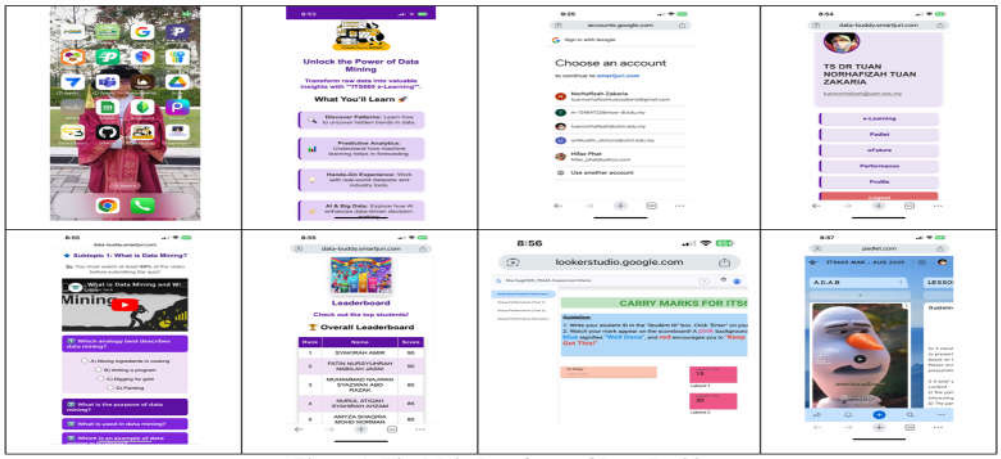


**Figure 1.**: The Main Interfaces of Data-Buddy

As a Progressive Web App (PWA), this application enables users to conveniently add it to their device's home screen without requiring a traditional installation, thus saving device storage while delivering an app-like experience. Students log in using Google authentication to ensure secure and seamless access. The interface is designed with a modern, mobile-friendly layout that features intuitive navigation, vibrant colors, and engaging icons, appealing to Gen Z learners. It includes clear menus, collapsible sections for quizzes and leaderboards, progress tracking, and a smooth user experience optimized for both desktop and mobile devices. The system includes several functional menus such as video module, quiz module, leaderboard, carry marks tracker and Padlet.

**Video Module**

This module delivers short, focused instructional videos for each topic. The objective is to align with students' current learning preferences, where short-form video content is more engaging and cognitively manageable. Students today tend to absorb information better through concise media that can be revisited multiple times. Dunleavy et al. (2022) demonstrated that brief, one-minute videos and short text summaries following lectures significantly improved students' understanding and ability to organize information. With this module, learners can watch videos repeatedly at their own pace, anytime and anywhere, which supports flexible revision habits and microlearning practices. It reduces cognitive load while enhancing topic retention after class hours.

**Quiz Module**

Each video is followed by a set of structured, topic-related questions. Students are allowed a maximum of three attempts, with immediate feedback (mark) provided after each try. The pedagogical intent is to encourage reflection and reinforcement of content right after viewing, thereby promoting active recall. This approach supports the transfer of visual content into long-term memory by activating cognitive engagement immediately after watching. The quiz acts as a formative tool to assess understanding and deepen learning, where it is a key element in bridging passive watching with active comprehension.

**Leaderboard**

Displays top-performing students to encourage healthy competition. Based on the quiz module. The objective of this module is to encourage competitive learning among students.

**Carry Mark Tracker**

Allows students to monitor their academic performance visually. Carry marks were visualized using Google Looker Studio, allowing both students and lecturers to interactively monitor performance trends. This dashboard provided insights into individual progress as well as group performance, offering a clearer academic picture through real-time visuals and comparisons.

**Padlet Integration**

Enhances interactive learning through collaborative posts, reflections, and feedback. Padlet is integrated with UiTM's ADAB Model, where students share inspiring videos and present inspiring stories in class (Tuan Zakaria, 2025).

## RESULTS AND DISCUSSION

A pilot implementation involving 15 students enrolled in a single class was conducted over a period of six weeks. Students used Data-Buddy to review course materials, attempt quizzes, monitor academic progress, and collaborate via Padlet. A satisfaction survey was conducted to evaluate perceived ease of use, engagement, and learning effectiveness. Preliminary findings indicate high satisfaction rates, with most respondents agreeing that the gamified features increased motivation and that the progress-tracking modules improved their self-assessment confidence.

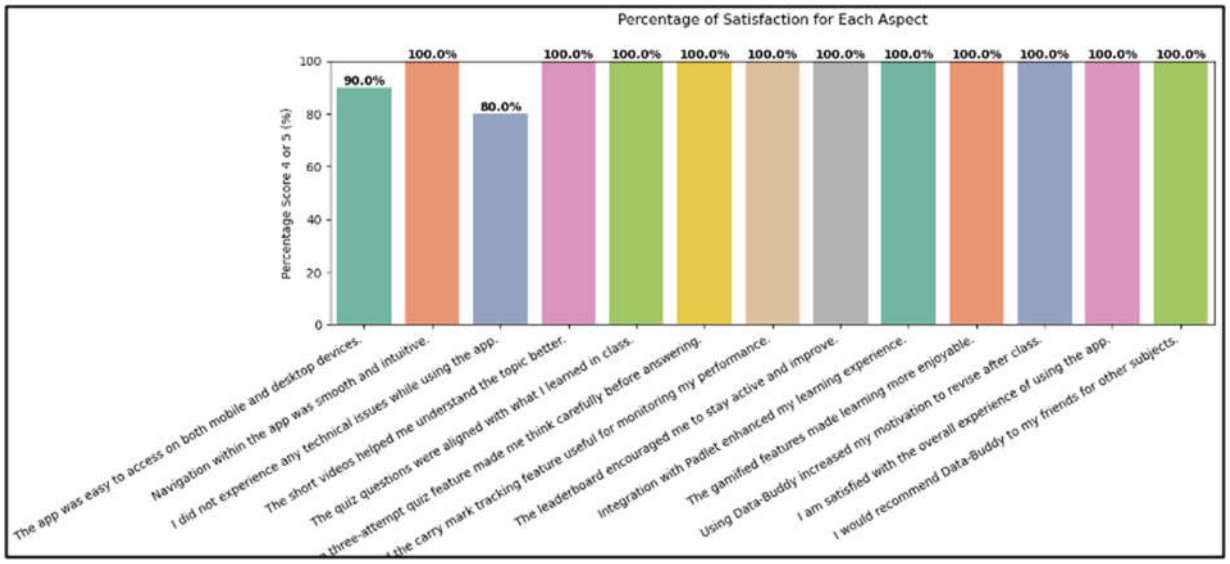


**Figure 2.**: Percentage of Scores 4 and 5 for All Aspects

Figure 2 depicts the percentage of respondents who rated each aspect of the Data-Buddy app with a satisfaction score of 4 and 5 (Agree and Strongly Agree). Most of the aspects achieved a perfect 100% of respondents rating them positively (score 4 or 5). The students' reviews were analyzed using a sentiment analysis method. Table 1 shows the sentiment value of students' comment.

**Table 1.**: The Sentiment Value of Students' Comments

| Student's Comment | Sentiment Value | Sentiment |
|---|---|---|
| Past year question sets, easy to access rather than EQPS | 0.4404 | Positive |
| easy to access | 0.4404 | Positive |
| The part where there is combine of revision, pyq features easy to understand especially with the quiz | 0.4404 | Positive |
| easily to detect my performance and doing quiz chapter by chapter. | 0.34 | Positive |
| The quizzes | 0 | Neutral |
| tracking my performance so that i have a room for improvement | 0 | Neutral |
| Quiziz . because i got to test my understanding in fun way | 0.5106 | Positive |

| Student's Comment | Sentiment Value | Sentiment |
|---|---|---|
| The part where you can simply share anything in there because it makes things much easier. | 0.6124 | Positive |
| Past year questions and quiz with video | 0 | Neutral |
| Easy to explore | 0.4404 | Positive |

Table 1 depicts the sentiment analysis performed on student feedback comments using VADER (Valence Aware Dictionary and sEntiment Reasoner), a lexicon and rule-based tool well-suited for analyzing short and informal text. The compound score from VADER, which ranges from -1 (most negative) to +1 (most positive), was used to determine the sentiment of each comment. Comments with compound scores greater than 0.05 were labeled Positive, those between -0.05 and 0.05 as Neutral, and those less than -0.05 as Negative. Most of the responses were labeled Positive, such as comments praising accessibility, quizzes, and ease of sharing information, with compound scores like 0.4404 and 0.6124. A few were categorized as Neutral, particularly short or non-emotive responses like "The quizzes" or general observations without explicit sentiment. No Negative comments were detected, suggesting overall satisfaction among students regarding the platform's features. This analysis offers a quantifiable overview of qualitative feedback and reinforces the system's effectiveness and acceptance.

## CONCLUSION

Data-Buddy presents an innovative, scalable, and inclusive platform that supports active learning through gamification, microlearning, and progress tracking. Its lightweight, PWA-based architecture minimizes access barriers while maximizing flexibility for students and educators. Future directions include expanding language options, integrating advanced learning analytics, and extending evaluation studies to larger cohorts. In this way, Data-Buddy aligns with SUSED2025's vision of sustainable, technology-enhanced education that is student-centred, accessible, and impactful.

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