



Design of a Digital Content Framework with Gamification and Progress-Tracking for Mobile Assisted Diabetes Self-Education

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Abstract—Research indicates that personalized diabetes education increases engagement and long-term self-management among patients. This study presents a structured and personalized framework for mobile-assisted self-diabetes education. The framework was developed as a component of the larger AIDCare system, which is an AI-supported diabetes management platform. In this framework, educational content is developed using H5P and hosted on a WordPress platform. Gamification features, including achievements, badges, leaderboards, and user analytics are integrated to support engagement. Real-time progress tracking is used to continuously monitor and record the progress of each user. The framework enables healthcare personnel to add, edit, or update educational content as needed, while also facilitating ongoing customization and alignment with clinical workflows. In addition, this study discusses implementation considerations and describes a pathway for integration with routine care and the evaluation of patient outcomes.

Keywords—Content Creation; Diabetes Education; Gamification; Learning Path; Real-time Progress Tracking

advanced healthcare technologies to meet the needs of people with diabetes.

Research on diabetes self-management and support has identified several factors that influence its complexity, ranging from socioeconomic, biological, and genetic determinants [3]. This diversity of factors calls for a personalized, structured education system that applies to everyone while having room to be personalized for each person (user) [4]. Additionally, numerous studies have also demonstrated the benefits of personalized diabetes self-management and education (DSMES) programs, including improved blood glucose control, lower risk of cardiovascular disorders, and lower risk of pregnancy failure [5] [6] [7]. Several studies have also found that the content of diabetes DSMES should be engaging for users to improve their memory retention and attendance at self-management education. Especially, the Gamification approach has been found to be effective by several studies [8] [9] [10].

I. INTRODUCTION

According to the World Health Organization (WHO), diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin, a hormone that regulates blood glucose, or when the body cannot effectively use the insulin it produces [1]. It is a chronic and permanent disease that adversely affects the quality of life of patients if mismanaged. This can lead to a shortened lifespan. Over time however, with advances in technology, several means to support diabetes self-management have been developed, chiefly mHealth applications and sensors. AIDCare, an artificial intelligence-supported diabetes management system [2], provides a diabetes management platform that is easy to use and combines

To offer the benefits of structured, personalized and gamified diabetes education, the content of the AIDCARE Education Module has been developed and its progress has been tracked to meet the needs of diabetes patients today and onward. This study contributes a structured and scalable approach for personalized DSMES content integrated with gamification and a lightweight progress-tracking protocol, designed for seamless integration into clinical workflows via the AIDCare platform. This study is organized as follows: Section II describes the methodology for content generation, validation, and design of the gamification and analytics framework; Section III covers progress tracking and server integration; Section IV discusses the results, usability considerations, and clinical implications;

and Section V concludes with a summary and directions for future work.

II. METHODOLOGY

The methodology underpinning the AIDCare Education Module blends content engineering, expert validation, and a lightweight progress-tracking framework to deliver structured, personalized diabetes self-management education within routine care. This section outlines the end-to-end process for generating learning content, validating it with clinicians, and implementing the gamification and analytics components, with an emphasis on cross-platform delivery, scalability, and alignment with clinical workflows. This section also explains the content-generation workflow, validation procedures, the design of the gamification and analytics framework, and the progress-tracking system, followed by integration considerations and evaluation plans.

A. Generation of Educational Content for Diabetic Patients



Fig. 1. Unified graph of learning paths created by healthcare professionals.

1) Creating a Learning Path for Education Structure:

To systematically create the educational content used in the module, a learning path based on the education received by a newly diagnosed diabetes patient was established with assistance from health professionals specializing in diabetes. The learning path consists of interrelated and non-sequential education modules, structured according to the user's health data and previously specified characteristics. The learning paths were designed to address the most common types of diabetes: type 1, type 2, and Gestational Diabetes. After the health professionals created the proper learning paths for each type, these paths were unified under one graph, as shown in

Fig. 1, and the graph was technically implemented using the JSON format to offer the created content in a structured way.

2) *Tools and Sources of Content Creation:* Educational content was developed using H5P, a framework that does not require coding knowledge to add or modify content to facilitate future inclusion or alteration of content by health professionals. The WordPress platform was chosen to host the educational content of the module because of its ease of management and the ability to be used within the application by implementing WebView, without requiring the user to use an external application. Furthermore, the content used during the creation of education was based on the several sources listed below for each type of content:

- The text content used in the education was developed based on sources approved by guiding healthcare professionals, mainly including the guidelines written by the Turkish Diabetes Foundation [11] and the Turkey Endocrinology and Metabolism Association [12], along with the website of the Turkish Diabetes Society [13].
- The video content was taken from the YouTube channel of a health specialist working at Kocaeli University Hospital's Endocrinology Clinic [14], if available; otherwise, it was left blank at this stage of the project. In the next phase of the project, videos from approved and contracted parties were added to replace the blank videos.
- The questions in the education content were developed using various online sources [15] [16] [?] and Google's GEMINI artificial intelligence. A Word file containing these questions was sent to health professionals for feedback. Afterwards, the questions currently in the educational content were modified in line with their feedback.
- The educational games, along with the "Food Care Card Game" or "Insulin Injection Card Game" that are used by diabetes specialist nurses during their education for individuals with diabetes, have been created for the education module, alongside games like "Hypoglycemia Puzzle" for gamification purposes.

3) *Validation of the Created Content:* The created content was presented to the guiding healthcare professionals, and their feedback was considered. Their main issues were that the content created by using the "Course Presentation" type was "too boring" and that the alternative videos used during the development period could trigger copyright issues. Subsequently, the content was developed using alternative types to diversify content, and videos taken from external sources were changed with blank videos to be replaced by approved videos later in the development cycle.

B. Gamification and Profile Analytics

Educational research on the impact of gamification on education, specifically in diabetes self-management education, is mentioned in the "Introduction". Guided by these studies, this education framework incorporates a three-component gamification framework for memory retention of self-management information and retaining long-term user engagement:

- **Achievement / Badge System:** The achievement system uses an event-driven architecture based on Django signals, to separate gamification and core logic. The server-side achievement table defines six badges (for now) that reward learning progress: *First Step, You're Not Alone, Draw Your Path, Consistent Learner, Fast Learner* and *education chain*. The business logic of this system is as follows: Django signals monitor the relevant models and when a condition is met, the corresponding UserAchievement record is updated (earned = True), as shown in Fig. 2. The operation is atomic, thus it avoids race conditions. Several signal to badge can be found below.

- Consistent Learner: opening at least one module every day for 30 consecutive days (award_consistent_student_badge).
- Fast Learner: completing ≥ 10 lessons at 100% within the last seven days (award_fast_student).
- Education Champion was awarded when all available lessons were completed (award_champion_badge_for()).

- **Leaderboard:** A PostgreSQL view named v_leaderboard ranks the top six users by completed lessons and total number of badges. The data were fetched via REST-Retrofit and rendered as RecyclerView cards on the home screen (Fig. 3).

- **Progress Analytics:** Records in UsersProcess and UserModuleAccess are summarized by a celery task triggered on every completion rate update. Three key indicators are stored in the user_stats view, which are *completed lessons* (completion_rate = 100), *total active time*, and *streak of consecutive days*.

This gamification framework boosts self-management motivation while the analytics layer delivers personalized feedback. As a result, users stay engaged longer and reach clinical goals more quickly.



Fig. 2. Gamification layer: earned badges and the top-six leaderboard rendered as RecyclerView cards.



Fig. 3. Progress-analytics dashboard showing completed courses, total active time, and current streak.

C. Progress Tracking and Server Integration

The *resume* and real-time completion-update features of H5P-based learning objects are implemented through a lightweight REST protocol with a minimal JSON load that connects the client and server. The approach delivers a consistent user experience to both web and Android clients, by allowing progress updates in real-time even without a stable internet connection, without requiring any additional plugins.

Client Layer – HTML Footer Script: A single JavaScript snippet, injected with the Code Snippets plugin into the footer of every H5P asset, fulfills two core duties: "*Resume*" and "*Progress Update*". During the education, the Javascript snippet The snippet listens to the H5P's native xAPI event. Every new "answered/completed/consumed" statement is then forwarded to the REST service in a compact JSON body containing only {user, education, completion_rate}. Therefore, network traffic is kept minimal and remains consistent across online and offline scenarios. When a user leaves and comes back to resume the the education, the most recent completion percentage for the user-content pair is fetched from the server as soon as the education page loads. When the H5P object emits the "loaded" signal, the timestamp is calculated by multiplying the stored percentage by the total duration T , allowing the learner to continue exactly where they are left off.

Android Layer – WebView Bridge: On a mobile device, the same HTML content is rendered in a local WebView. Three refinements are applied: (i) the JavaScript console output is redirected to Logcat for field debugging; (ii) an online updateProgress(%) bridge allows JavaScript to post percentages, and (iii) values are also cached in a Room database, so that progress is never lost even when connectivity is interrupted.

Server Layer – UsersProcess Endpoint: A single Django REST endpoint stores completion data: GET returns to the previous state; POST registers a newly opened lesson at 0 %; PATCH updates only the completion_rate field.

Because the schema is intentionally lean, clients do not need additional transformations.

The completion rate is dynamically calculated based on the number of interactive blocks (n) within each education, as shown in Table I. For example, in an education that has five interactive blocks (games, videos, text, etc.), each block would contribute 20% to the total progression rate. A user who has completed three of these blocks would have a completion rate of 60%. Static headings and images are only used for information purposes and are excluded from the calculation.

TABLE I
PER-BLOCK DYNAMIC COMPLETION CONTRIBUTION

HSP Item	Weight
Any interactive block	$100/n$
Static text/image	0

III. DISCUSSION

The prototype of this digital content framework, which includes the content creation system, gamification elements, and progress tracking, has been well-received by healthcare professionals at Kocaeli University Hospital's Endocrinology Clinic for its adaptability and ease of use. However, further testing is required to validate the reliability with different types of patients. Additionally, since there haven't been many tests of this framework or its gamification elements, there can only be assumptions regarding the effect of the gamification elements based on previous studies, such as improving user engagement or information retention. Overall, while the system has been well-received and deemed to have the potential to provide a solid foundation of content for digital DSMES programs, it needs to be validated by real-world testing regarding its impact on health metrics, such as HbA1C and blood glucose levels, and user engagement to demonstrate clinical effectiveness and reliability under different conditions.

IV. CONCLUSION

This study presented the design and development of a digital content framework that underpins the AIDCARE Education Module. We have proposed a structured and scalable approach for delivering personalized diabetes self-management education, integrated with gamification and a lightweight progress-tracking protocol, designed for integration into clinical workflows via the AIDCARE platform. In the future, we plan to strengthen security to meet established standards, replace placeholder videos with clinician-approved content, and expand both educational material and gamification features (for example, adding more achievements and refining the point distribution). Usability testing with individuals diagnosed with diabetes was also planned to assess the module's effectiveness and user experience. The results and insights from these tests will be used to further refine the educational experience of this module.

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