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An AI-Assisted Mobile Learning Application for Supporting EFL Writing in Distance Higher Education

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Abstract

Abstract (English)

Writing instruction in distance higher education requires more than digital access to assignments; it requires pedagogically meaningful feedback, opportunities for revision, and mechanisms that help learners regulate their writing process. However, EFL students in open and distance learning contexts often receive delayed feedback and have limited opportunities for continuous tutor interaction. This study develops and functionally evaluates WriteCoach, an AI-assisted mobile learning application designed to support EFL writing through a human-AI feedback model. The study employed a design and development research approach consisting of needs analysis, pedagogical and system design, prototype development, AI feedback integration, and black-box functional testing. WriteCoach integrates student writing practice, AI-generated formative feedback on grammar, clarity, and structure, tutor-mediated assessment, quizzes, progress monitoring, and role-based learning management for students, tutors, and administrators. The results show that the prototype successfully implemented the core pedagogical workflow: students compose texts, receive initial AI feedback for revision, submit writing to tutors, obtain human assessment, and monitor their progress. Functional testing confirmed that the main learning, feedback, assessment, and management features operated according to the expected outputs. The main contribution of this study is a practical pedagogical model for combining immediate AI feedback with tutor judgment in mobile-supported EFL writing learning. Future studies should evaluate usability, learner perception, feedback quality, and the effectiveness of WriteCoach in improving writing performance and self-regulated learning.

Keywords: *AI feedback; distance education; EFL writing; mobile learning; WriteCoach*

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Abstrak (Indonesia)

Pembelajaran writing dalam pendidikan tinggi jarak jauh tidak hanya membutuhkan akses digital terhadap tugas, tetapi juga umpan balik yang bermakna secara pedagogis, kesempatan revisi, dan mekanisme yang membantu mahasiswa mengatur proses menulisnya secara mandiri. Namun, mahasiswa EFL dalam konteks pendidikan terbuka dan jarak jauh sering menghadapi keterlambatan umpan balik serta keterbatasan interaksi berkelanjutan dengan tutor. Penelitian ini mengembangkan dan mengevaluasi secara fungsional WriteCoach, yaitu aplikasi mobile learning berbantuan AI yang dirancang untuk mendukung pembelajaran EFL writing melalui model umpan balik human-AI. Penelitian ini menggunakan pendekatan design and development research yang meliputi analisis kebutuhan, perancangan pedagogis dan sistem, pengembangan prototipe, integrasi umpan balik AI, serta pengujian fungsional black-box. WriteCoach mengintegrasikan latihan menulis, umpan balik formatif berbasis AI pada aspek grammar, clarity, dan structure, penilaian tutor, kuis, pemantauan progres, serta manajemen pembelajaran berbasis peran untuk mahasiswa, tutor, dan administrator. Hasil penelitian menunjukkan bahwa prototipe berhasil mengimplementasikan alur pedagogis utama: mahasiswa menulis teks, menerima umpan balik awal dari AI untuk revisi, mengirimkan tulisan kepada tutor, memperoleh penilaian manusia, dan memantau progres belajar. Pengujian fungsional menunjukkan bahwa fitur pembelajaran, umpan balik, penilaian, dan pengelolaan sistem berjalan sesuai keluaran yang diharapkan. Kontribusi utama penelitian ini adalah model pedagogis praktis yang menggabungkan umpan balik cepat berbasis AI dengan penilaian tutor dalam pembelajaran EFL writing berbasis mobile. Penelitian selanjutnya perlu mengevaluasi usability, persepsi pengguna, kualitas umpan balik, serta efektivitas WriteCoach terhadap peningkatan performa menulis dan self-regulated learning mahasiswa.

Kata kunci: *AI feedback; mobile learning; pembelajaran jarak jauh; pembelajaran writing; WriteCoach.*

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1. INTRODUCTION

Writing is a central competence in English as a Foreign Language (EFL) learning because it requires learners to organize ideas, apply grammatical accuracy, use appropriate vocabulary, and construct coherent texts. In higher education, writing competence is essential for academic communication, assignment completion, report writing, and scholarly literacy. However, EFL writing remains challenging because students often need repeated practice, revision opportunities, and timely feedback to improve the quality of their writing (Almusharraf, 2025; Fan & Ma, 2022; Shi & Aryadoust, 2024).

This challenge becomes more complex in open and distance higher education. Students in distance learning environments are expected to regulate their own learning, manage flexible study schedules, and interact with tutors through mediated platforms rather than continuous face-to-face instruction (Anfas & Zainuddin, 2018) This condition is relevant to Universitas Terbuka, where students come from diverse geographical, occupational, and academic backgrounds. In this context, writing learning requires

a digital environment that allows students to practice writing, obtain feedback, revise their drafts, submit their work to tutors, and monitor their learning progress.

The need for feedback is theoretically important in writing learning. Feedback theory emphasizes that effective feedback should help learners understand their learning goals, evaluate their current performance, and identify what actions are needed for improvement (Hattie & Timperley, 2007). In formative assessment, feedback should not only inform students about errors, but also help them regulate their learning, revise their work, and develop greater responsibility for their own progress (Nicol & Macfarlane-Dick, 2006; Shute, 2008). Therefore, writing feedback should be timely, specific, and actionable so that students can use it during the revision process rather than only after final assessment.

This theoretical issue is closely related to self-regulated learning. Self-regulated learning refers to learners' ability to set goals, select strategies, monitor progress, and evaluate outcomes during learning activities (Pintrich, 2000; Zimmerman, 2002). In EFL writing, self-regulated learning is important because students need to plan their writing, draft their ideas, respond to feedback, revise their text, and reflect on the quality of their work. In distance higher education, this becomes more critical because students have fewer direct classroom interactions and must take greater responsibility for managing their own learning process.

Technology-assisted language learning has become an important response to these needs. Digital learning systems can extend access to learning resources, support flexible participation, and provide interactive learning experiences beyond the limitations of conventional classroom settings (Buddha et al., 2024; Sarker et al., 2019; Wang et al., 2024). Mobile learning is particularly relevant for distance education because it enables students to access learning activities through devices that are commonly used in daily life. Previous studies show that mobile learning can support flexible access and learner-centered participation in higher education when it is integrated with appropriate pedagogical design (Crompton & Burke, 2018; Kukulska-Hulme & Viberg, 2018)

Recent advances in artificial intelligence (AI) further expand the possibilities for supporting writing learning. AI-based systems can analyze learner-generated texts and provide feedback on linguistic and structural aspects of writing (Shi & Aryadoust, 2024). AI-powered English learning systems have been reported to support personalized and adaptive learning through natural language processing and automated feedback (Almusharraf, 2025; Tang, 2026). In writing learning, automated writing evaluation can provide faster responses than manual correction and may support writing engagement and revision, although feedback validity, accuracy, transparency, and learner interpretation remain important concerns (Kara & Koban, 2023; Liu, 2024; Tang, 2026).

Despite its potential, AI feedback should not be treated as a complete replacement for tutor feedback. Writing assessment requires contextual interpretation, pedagogical judgment, and guidance for meaningful revision. A systematic review of AI-assisted feedback in education emphasizes that AI feedback should be transparently and pedagogically integrated into the learning process rather than used as isolated automated output (Ba et al., 2025). Large language models also create opportunities for educational support, but they raise challenges related to feedback reliability, ethics, academic integrity, and appropriate instructional use (Kasneci et al., 2023). Therefore, an appropriate design for AI-supported writing learning should position AI as an initial formative feedback provider, while tutors remain responsible for final assessment and instructional guidance.

Although previous studies have examined mobile learning, automated writing evaluation, and AI-assisted feedback, several gaps remain in the context of EFL writing in distance higher education. First, many AI writing tools are still designed as standalone correction systems that focus mainly on grammar checking, sentence improvement, or text generation, rather than supporting the complete pedagogical cycle of writing practice, feedback, revision, tutor assessment, and progress monitoring. Second, prior studies on AI-assisted writing feedback have often emphasized the speed and automation of feedback, while less attention has been given to how such feedback supports formative assessment and self-regulated learning. Third, in open and distance learning contexts, AI feedback needs to be connected with tutor-mediated assessment because writing development requires not only immediate corrective input but also human pedagogical judgment. Therefore, there is a need for an integrated mobile-supported human-AI feedback model that combines automated formative feedback, student revision,

tutor assessment, role-based learning management, and progress monitoring in one learning environment.

To address this gap, this study develops WriteCoach, an AI-assisted mobile learning application for supporting EFL writing in distance higher education. WriteCoach is designed based on a human-AI feedback model involving three user roles: students, tutors, and administrators. Students use the application to complete writing exercises, receive AI-generated formative feedback, take quizzes, view grades, and monitor learning progress. Tutors use the application to manage classes, question banks, quiz assignments, writing submissions, grading, and class analytics. Administrators use the system to manage users, approve registrations, manage classes, and view system reports.

Technically, WriteCoach was developed using Dart and Flutter, with Supabase PostgreSQL as the cloud database, Supabase Auth for authentication, and Gemini AI for writing analysis. The AI feedback focuses on three aspects of writing: grammar, clarity, and structure. The main contribution of this study is the development of an integrated mobile-supported human-AI feedback model for EFL writing learning in distance higher education. Therefore, this study aims to design, implement, and functionally evaluate WriteCoach as a prototype that combines immediate AI-generated formative feedback, tutor-mediated assessment, role-based learning management, and progress monitoring in one mobile learning environment.

2. RELATED WORK

2.1 EFL Writing Learning in Distance Higher Education

Writing is a central competence in English as a Foreign Language (EFL) learning because it requires learners to organize ideas, apply grammatical accuracy, use appropriate vocabulary, and construct coherent texts. In higher education, writing competence is essential for academic communication, assignment completion, report writing, and scholarly literacy. However, EFL writing remains challenging because students need repeated practice, revision opportunities, and timely feedback to improve the quality of their writing (Kara & Koban, 2023; Lee et al., 2025; Ningsih et al., 2022).

This challenge becomes more complex in open and distance higher education. Students in distance learning environments are expected to regulate their own learning, manage flexible study schedules, and interact with tutors through mediated platforms rather than continuous face-to-face instruction (Liao & Chai, 2025; Nurhadi, 2020). In such contexts, learning success depends not only on access to digital materials, but also on students' ability to plan, monitor, and evaluate their own learning process. This condition is closely related to self-regulated learning, in which learners actively control their goals, strategies, motivation, and performance during learning activities (Pintrich, 2000). For EFL writing, self-regulation is particularly important because students must revise their drafts, respond to feedback, and improve their writing through repeated cycles of practice.

Feedback plays a critical role in this process. According to feedback theory, effective feedback helps learners understand where they are going, how they are performing, and what actions are needed to improve their work (Hattie & Timperley, 2007; Sreela et al., 2025). In formative assessment, feedback should support students in identifying learning gaps, revising their work, and developing greater responsibility for their own learning (Park et al., 2023; Sadjati et al., 2014). However, in distance higher education, EFL students often experience delayed feedback and limited opportunities for continuous interaction with tutors. As a result, students may have difficulty revising their writing at the right time and may depend heavily on final assessment rather than ongoing formative guidance.

Technology-assisted language learning has become an important response to these pedagogical challenges. Digital learning systems can extend access to learning resources, support flexible participation, and provide interactive learning experiences beyond the limitations of conventional classroom settings (Mughal et al., 2026; Sarker et al., 2019; Zhonggen, 2015). Mobile-assisted language learning is particularly relevant for distance education because mobile devices enable learners to access learning activities anytime and anywhere, support repeated practice, and encourage learner-centered participation (Crompton & Burke, 2018; Guo et al., 2024; Kukulska-Hulme & Shield, 2008). Therefore, mobile learning can provide an appropriate environment for supporting EFL writing practice in open and distance learning contexts.

Recent advances in artificial intelligence (AI) further expand the possibilities for supporting writing learning. AI-based systems can analyze learner-generated texts and provide feedback on linguistic and

structural aspects of writing (Shi & Aryadoust, 2024). AI-powered English learning systems have been reported to support personalized and adaptive learning through natural language processing and automated feedback (Almusharraf, 2025; Ma et al., 2025). In writing learning, automated writing evaluation can provide faster responses than manual correction and may support writing engagement and revision, although feedback validity, accuracy, transparency, and learner interpretation remain important concerns (Fan & Ma, 2022; Liu, 2024). A systematic review of AI-assisted feedback also emphasizes that AI feedback is more meaningful when it is integrated into pedagogical processes rather than used as isolated automated output (Ba et al., 2025).

Despite its potential, AI feedback should not be treated as a complete replacement for tutor feedback. Writing assessment requires contextual interpretation, pedagogical judgment, and guidance for meaningful revision. Large language models offer opportunities for education, but they also raise challenges related to accuracy, ethics, academic integrity, and appropriate instructional (Hur & Ji, 2025) Therefore, an appropriate design for AI-supported writing learning should position AI as an initial formative feedback provider, while tutors remain responsible for final assessment and instructional guidance. This human-AI feedback model is pedagogically important because it combines the immediacy of automated feedback with the contextual judgment of human tutors.

Many existing AI writing tools are designed as standalone correction systems. They often focus on grammar checking, sentence improvement, or text generation without being integrated into a broader learning management workflow. In distance higher education, writing support should not only provide automated feedback but also support writing exercises, revision, submission management, tutor grading, quizzes, class management, progress tracking, and role-based administration. Without these components, AI feedback may remain disconnected from the actual teaching, assessment, and learning process.

To address this gap, this study develops WriteCoach, an AI-assisted mobile learning application for supporting EFL writing in distance higher education. WriteCoach is designed based on a human-AI feedback model involving three user roles: students, tutors, and administrators. Students use the application to complete writing exercises, receive AI-generated formative feedback, take quizzes, view grades, and monitor learning progress. Tutors use the application to manage classes, question banks, quiz assignments, writing submissions, grading, and class analytics. Administrators use the system to manage users, approve registrations, manage classes, and view system reports.

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2.5 Summary of Related Work and Study Contribution

The related work shows that technology-assisted language learning, mobile learning, AI-assisted writing feedback, generative AI, and learning analytics have become important directions in educational technology research (Ba et al., 2025; Covid-, n.d.; Haendchen Filho et al., 2025). However, several gaps remain. First, many AI writing tools focus primarily on automated correction and are not fully integrated with tutor grading and learning management. Second, many mobile learning studies emphasize access and engagement but do not specifically address AI-assisted writing feedback for distance higher education students. Third, limited studies have presented a practical prototype that combines AI feedback, tutor evaluation, role-based access, quiz management, and learning analytics in one mobile application.

This study contributes by developing WriteCoach as an AI-assisted mobile application for EFL writing learning in distance higher education. The system integrates mobile access, Gemini AI feedback, tutor-mediated grading, user and class management, quiz activities, and learning analytics. Thus, WriteCoach is positioned not as a standalone writing correction tool but as an integrated learning support system for distance higher education.

3. METHODS

This study employed a design and development research approach to produce and functionally evaluate WriteCoach, an AI-assisted mobile application for supporting EFL writing learning in distance higher education. This approach was selected because the main objective of the study was to develop an educational technology product, document its system design, implement its main features, and validate its functionality. The study did not examine learning effectiveness through experimental intervention; instead, it focused on prototype development, system integration, and functional validation.

The method was organized into five main components: research design and context, needs analysis, system design and architecture, application development and AI feedback integration, and functional testing. This structure was used to ensure that the application was developed based on the needs of distance education students while also supporting the operational roles of tutors and administrators.

3.1 Research Design and Context

The development procedure consisted of six stages: needs analysis, system design, prototype development, AI feedback integration, implementation, and functional testing. The procedure began with identifying challenges in writing learning in distance higher education, followed by translating the identified problems into functional and non-functional requirements. The next stages involved designing the application architecture, developing the mobile prototype, integrating Gemini AI as an automated feedback component, implementing role-based features, and testing the application using black-box testing.

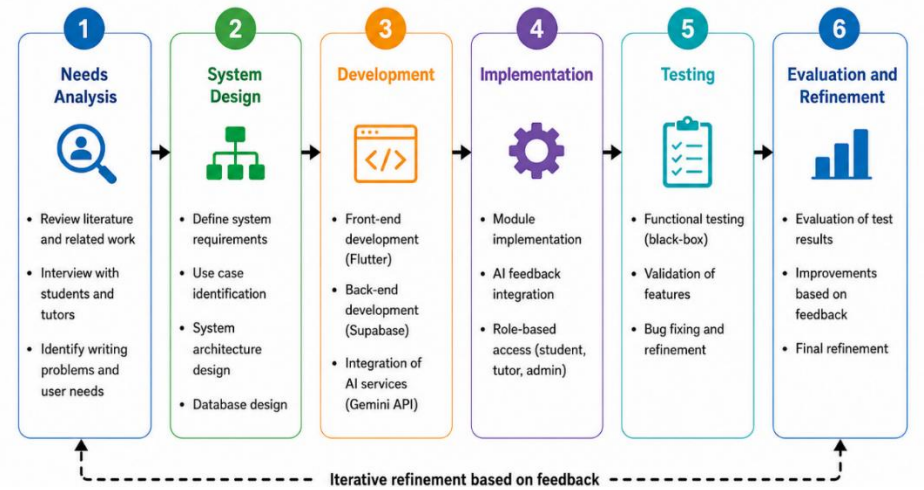

Figure 1. Research and development procedure of the WriteCoach application

Figure 1 presents the development procedure used in this study. The workflow shows that WriteCoach was developed through a sequential but iterative process. Each stage produced outputs that informed the next stage, from requirement formulation to system testing.

The application was developed for the context of writing learning at Universitas Terbuka, an open and distance higher education institution. In this context, students require flexible access to writing practice, timely feedback, submission mechanisms, and progress monitoring. The object of this study was the WriteCoach prototype, not a classroom intervention. Therefore, the study focused on system feasibility and functional readiness rather than measuring student learning gains.

3.2 Needs Analysis and System Requirements

Needs analysis was conducted to identify the learning, user, and technical requirements of the application. Learning needs focused on writing practice, initial feedback, and progress monitoring. User needs were derived from three main roles: students, tutors, and administrators. Technical needs included mobile access, authentication, cloud-based data management, AI-assisted writing analysis, and functional testing.

Table 1. Needs analysis of the WriteCoach application

Dimension	Identified need	Design implication
Learning	Students need flexible writing practice and timely feedback	Writing exercise and AI feedback modules were implemented
Learning	Students need to monitor their learning outcomes	Grade history and progress tracking were provided
Tutor	Tutors need efficient submission review and grading	Submission review and grading modules were implemented
Tutor	Tutors need quiz and question management	Question bank and quiz assignment features were provided
Administrator	Administrators need user and class management	User management and class management modules were implemented
Technical	The system needs secure cloud data management	Supabase PostgreSQL, Supabase Auth, and role-based access were used
Technical	The system needs automated writing analysis	Gemini AI was integrated into the writing feedback workflow

Table 1 shows that the system requirements were derived from the writing learning context and the responsibilities of each user. These requirements became the basis for determining the system modules, application workflow, database structure, and testing indicators.

3.3 System Design and Architecture

The system design translated the identified requirements into a technical structure. The design included role-based access, application workflow, service-based architecture, backend integration, and database organization. The application supports three user roles. Students access writing exercises, AI feedback, quizzes, grades, and progress tracking. Tutors access class management, question bank, quiz assignment, submission review, grading, and class analytics. Administrators access user management, registration approval, class management, and system reports.

Instead of presenting all technical diagrams separately, the design is summarized through the system architecture. This architecture represents the interaction among the mobile application, service layer, Supabase backend, Gemini AI, and supporting services.

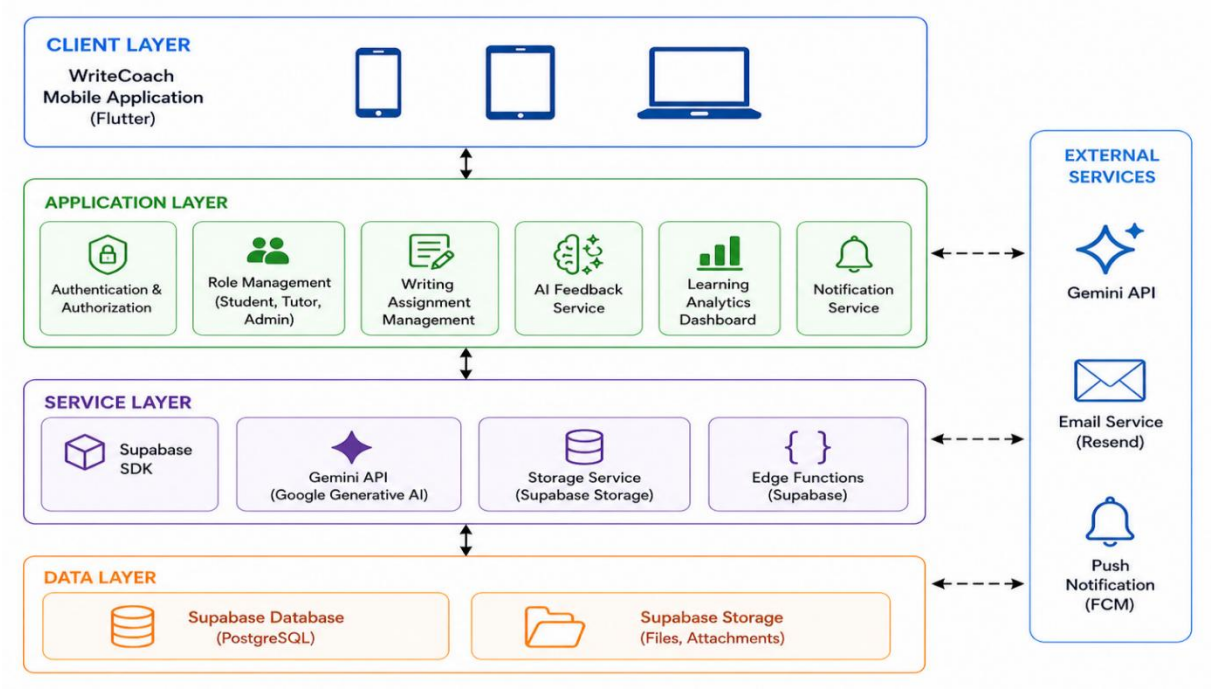

Figure 2. System architecture of the WriteCoach application

Figure 2 shows that the Flutter mobile application communicates with a service layer that separates the main system functions. The service layer includes authentication, submission management, question bank management, grading, analytics, user management, and AI feedback services. These services connect to Supabase for database management, authentication, storage, realtime updates, and selected server-side functions. Gemini AI is integrated as an external AI service for writing analysis.
The database was implemented using Supabase PostgreSQL. The main entities include authentication users, user profiles, classes, writing exercises, writing submissions, grades, question banks, question options, quiz assignments, quiz submissions, and quiz answers. These entities support the complete learning workflow from user registration to writing submission, tutor grading, quiz activity, and analytics.

Table 2. Main database entities in WriteCoach

Entity	Function
auth.users	Stores authentication data managed by Supabase Auth
user_profiles	Stores user profile information, role, class, and avatar
classes	Stores class data
exercises	Stores writing exercise data
submissions	Stores student writing submissions
grades	Stores tutor scores and feedback
question_bank	Stores multiple-choice and listening questions
question_options	Stores answer options for each question
quiz_assignments	Stores quiz assignment data for classes
quiz_submissions	Stores student quiz submission records
quiz_answers	Stores student answers for individual quiz items

Table 2 summarizes the main database entities used in WriteCoach. The database design supports role-based learning activities, writing assessment, quiz management, and learning analytics.

3.4 Application Development and AI Feedback Integration

The application was developed using Dart and Flutter. Flutter was selected because it supports cross-platform mobile development and consistent user interface implementation. Dart was used to implement the application logic, validation, navigation, service functions, and interface behavior.
WriteCoach follows a service-based architecture. Each major function was implemented as a separate service to improve modularity and maintainability. The main services include AuthService, SubmissionService, QuestionBankService, GradeService, GeminiGrammarService, AnalyticsService, and UserService.

Table 3. Main services implemented in WriteCoach

Service	Function
AuthService	Handles login, registration, logout, and role identification
SubmissionService	Manages writing submissions and retrieval
QuestionBankService	Manages question creation, question upload, and question retrieval
GradeService	Manages tutor scores and feedback
GeminiGrammarService	Connects the application with Gemini AI for writing analysis
AnalyticsService	Organizes progress, class, and system analytics data
UserService	Manages user profile and role-based user information

The AI feedback feature was implemented by integrating Gemini AI into the writing exercise workflow. When students complete a writing exercise, the text can be analyzed by the AI service. The analysis focuses on three aspects: grammar, clarity, and structure. The feedback is presented as an initial diagnostic response, not as a final grade. Students can use the feedback for revision, while tutors remain responsible for final evaluation.

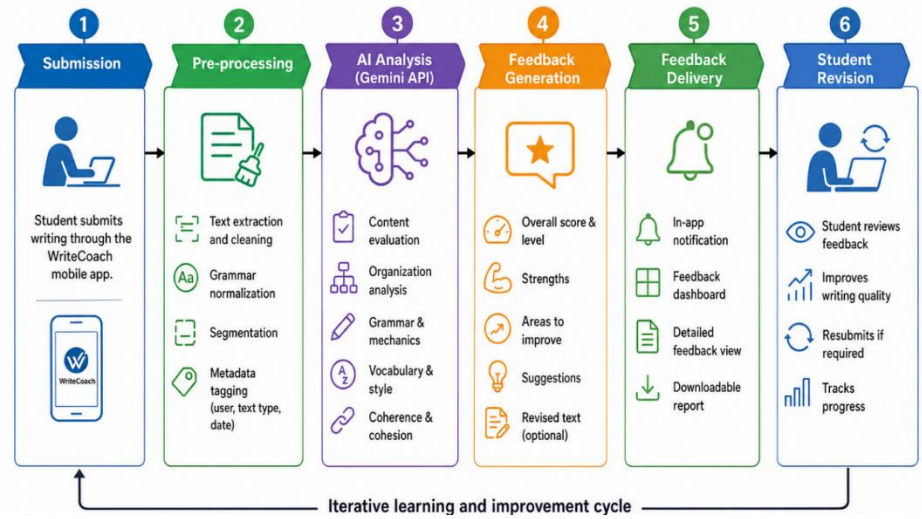

Figure 3. AI feedback workflow in WriteCoach

Figure 3 shows the AI feedback workflow. Students write a response, the application sends the text to Gemini AI, the AI analyzes the writing, and the system displays feedback on grammar, clarity, and structure. After reviewing the feedback, students may submit their writing to the tutor for final grading.

Table 4. AI feedback aspects in WriteCoach

Aspect	Description	Output
Grammar	Evaluates grammatical accuracy and sentence-level correctness	Grammar score and improvement suggestions
Clarity	Evaluates clarity and readability of student ideas	Clarity score and clarity-related suggestions
Structure	Evaluates organization and coherence of writing	Structure score and structure-related suggestions

Table 4 describes the AI feedback aspects implemented in the application. These aspects were selected because they represent fundamental dimensions of writing quality and are suitable for initial writing feedback.

3.5 Functional Testing and Data Analysis

Functional testing was conducted using black-box testing. This method was selected because the study aimed to verify whether the application features produced the expected outputs based on user actions. The internal source code was not evaluated in this testing procedure. Instead, each feature was tested from the user perspective using scenarios derived from the functional requirements.

The tested functions included login, registration, role-based access, writing exercise, AI feedback, writing submission, quiz activity, tutor grading, question bank management, user management, class management, analytics, and offline cache. Each test scenario consisted of a tested function, input or user action, expected output, and result status.

Table 5. Functional testing indicators

No	Tested function	Testing indicator
1	Login	User can enter the system with valid credentials and correct role
2	Registration	New account data can be submitted and stored
3	Role-based access	User sees features according to role
4	Writing exercise	Student can write and save writing input
5	AI feedback	System displays grammar, clarity, and structure feedback
6	Writing submission	Submission is stored and visible to tutor
7	Quiz	Student can answer quiz items and receive score
8	Tutor grading	Tutor can submit score and feedback

9	Question bank	Tutor can create and upload questions
10	User management	Administrator can manage user data
11	Class management	Administrator can manage class data
12	Analytics	System displays learning and system analytics
13	Offline cache	Student answers can be stored temporarily when offline

Table 5 presents the indicators used to validate the main functions of the application. A feature was considered successful when the actual system response matched the expected output in the test scenario.

The data analyzed in this study consisted of design outputs, implementation results, and functional testing results. Design outputs were analyzed descriptively to explain the system architecture, user roles, database structure, and workflow. Implementation results were analyzed by mapping the developed features to the requirements identified during needs analysis. Functional testing results were analyzed by comparing expected outputs with actual system responses.

3.6 Methodological Scope

This study was limited to prototype development and functional evaluation. It did not conduct experimental testing of students' writing improvement, large-scale usability testing, or long-term implementation in official course delivery. Therefore, the findings should be interpreted as evidence of prototype feasibility rather than evidence of learning effectiveness. Future studies should evaluate WriteCoach through usability testing, user perception analysis, and pre-test/post-test designs to examine its impact on writing learning outcomes.

4. RESULTS

This section presents the implementation and functional evaluation results of WriteCoach as an AI-assisted mobile learning application for supporting EFL writing in distance higher education. The results are presented not only as technical implementation outcomes, but also as evidence of how the application supports the pedagogical workflow of writing practice, AI-generated formative feedback, student revision, tutor-mediated assessment, and progress monitoring. The results are organized into role-based pedagogical workflow, AI feedback output, student revision flow, integration between AI feedback and tutor assessment, interface implementation, role-based AI feedback testing, and overall functional testing.

4.1 Role-Based Pedagogical Workflow Implementation

The main result of this study is a functional prototype of WriteCoach that integrates mobile writing practice, AI-generated formative feedback, tutor-mediated assessment, quizzes, learning progress monitoring, and role-based learning management. The application was developed using Flutter and Dart for the mobile interface, Supabase PostgreSQL and Supabase Auth for backend services, and Gemini AI for writing feedback generation.

WriteCoach was implemented for three user roles: students, tutors, and administrators. Each role has different access rights and pedagogical functions. The student role focuses on writing practice, receiving AI feedback, revising writing, submitting work, completing quizzes, viewing grades, and monitoring progress. The tutor role focuses on managing classes, reviewing submissions, assigning quizzes, providing grades, and giving human feedback. The administrator role focuses on approving users, managing classes, and monitoring system-level reports.

Table 6. Role-based pedagogical functions in WriteCoach

Role	Implemented features	Pedagogical function
Student	Writing exercises, AI feedback, writing submission, quizzes, grades, progress tracking	Supports writing practice, formative feedback reception, revision, self-monitoring, and learner autonomy
Tutor	Class management, question bank, quiz assignment, submission review, grading, class analytics	Supports instructional control, human assessment, pedagogical feedback, and learning supervision

Administrator	User management, registration approval, class management, system reports	Supports learning administration, user validation, class organization, and system monitoring

Table 6 shows that WriteCoach was implemented not merely as a writing correction tool, but as an integrated learning environment. The student features support self-regulated learning by allowing students to practice, receive feedback, revise their writing, and monitor their progress. The tutor features ensure that AI feedback does not replace human assessment. Instead, AI feedback functions as initial formative support, while tutors remain responsible for final grading and instructional judgment.

4.2 AI Feedback Output and Pedagogical Interpretation

The AI feedback module is the central component of WriteCoach. In the student workflow, learners write a response based on a writing exercise and request AI analysis before submitting their work to the tutor. The system sends the student's text to Gemini AI, and the AI returns feedback in three categories: grammar, clarity, and structure.

To provide concrete evidence of the AI feedback function, Table 7 presents an example of student writing input and AI-generated feedback produced by the system.

Table 7. Example of AI feedback output in WriteCoach

Component	Example output
Writing prompt	Write a short paragraph about your daily learning routine.
Student draft	"I study English every night because I want improve my skill. Sometimes I difficult to write sentence, but I try practice with my phone."
Grammar feedback	Some sentences need grammatical correction. For example, "I want improve my skill" should be revised to "I want to improve my skills." The phrase "I difficult to write sentence" should be revised to "I find it difficult to write sentences."
Clarity feedback	The main idea is understandable, but some sentences need clearer expression. The student should explain what kind of English skills are being improved and how mobile practice helps the learning process.
Structure feedback	The paragraph has a clear topic, but it can be improved by adding a supporting sentence and a concluding sentence. The student may organize the paragraph into: daily routine, difficulty, and improvement strategy.
Pedagogical function	The feedback helps the student identify language errors, improve sentence clarity, and reorganize ideas before submitting the writing to the tutor.

Table 7 shows that the AI feedback output provides actionable suggestions rather than only identifying errors. The feedback guides students to revise sentence-level accuracy, improve idea expression, and strengthen paragraph organization. Pedagogically, this supports formative feedback because students receive immediate guidance before final assessment. The AI feedback therefore functions as a revision aid, not as a replacement for tutor feedback.

4.3 Student Writing, AI Feedback, Revision, and Submission Flow

The student workflow was implemented as a sequence of writing practice, AI feedback, revision, and submission. This flow is important because EFL writing improvement requires repeated practice and opportunities for revision. WriteCoach allows students to use AI feedback before submitting their final draft to the tutor.

Table 8. Example of student usage flow in WriteCoach

Step	Student activity	System response	Learning function
1	Student selects a writing exercise	The application displays the writing prompt and input form	Provides structured writing practice
2	Student writes an initial draft	The application stores the draft temporarily	Supports drafting process
3	Student requests AI feedback	Gemini AI analyzes grammar, clarity, and structure	Provides immediate formative feedback

4	Student reads feedback	The application displays targeted suggestions	Supports reflection and self-correction
5	Student revises the draft	Student improves the text based on AI feedback	Supports self-regulated revision
6	Student submits final draft	The submission is stored and becomes visible to tutor	Connects AI feedback with tutor assessment
7	Student views grade and tutor feedback	The application displays tutor score and comments	Supports learning evaluation and progress monitoring

Table 8 demonstrates that WriteCoach connects AI feedback with a complete learning process. The student does not only receive automated correction; instead, the student moves through a learning cycle of drafting, receiving feedback, revising, submitting, and reviewing tutor assessment. This flow supports the pedagogical idea that feedback should guide learners toward improvement before final evaluation.

4.4 Integration Between AI Feedback and Tutor-Mediated Assessment

A key result of the prototype is the integration between AI-generated feedback and tutor-mediated assessment. After students revise and submit their writing, tutors can access the submitted text, review student work, provide scores, and add qualitative feedback. This confirms that WriteCoach applies a human-AI feedback model.

Table 9. Integration between AI feedback and tutor assessment

Component	Function in WriteCoach	Pedagogical role
AI feedback	Provides immediate feedback on grammar, clarity, and structure	Initial formative support
Student revision	Allows students to improve writing before submission	Self-regulated learning activity
Tutor review	Enables tutors to read final student submission	Human interpretation and instructional judgment
Tutor grading	Allows tutors to provide score and written feedback	Final assessment and pedagogical validation
Progress tracking	Displays grades and learning records	Reflection and monitoring

Table 9 shows that the AI and tutor components are connected in one workflow. AI supports early-stage writing revision, while tutors provide final evaluation. This design is important because writing assessment requires contextual understanding, which cannot be fully replaced by automated feedback. The integration also reduces the risk of treating AI output as final judgment. Instead, AI feedback is positioned as a preparatory step before human assessment.

4.5 Interface Implementation

The user interface was implemented according to the three user roles. The student interface prioritizes writing activities, AI feedback, quizzes, grades, and progress monitoring. The tutor interface prioritizes class management, question bank management, submission review, grading, and analytics. The administrator interface prioritizes user management, class management, registration approval, and system analytics.

To keep the article concise and consistent with the initial reporting design, the interface implementation is presented as one composite figure showing representative screens from the application. This figure demonstrates that the prototype has been implemented beyond the design stage and that the main workflows are available in the system.

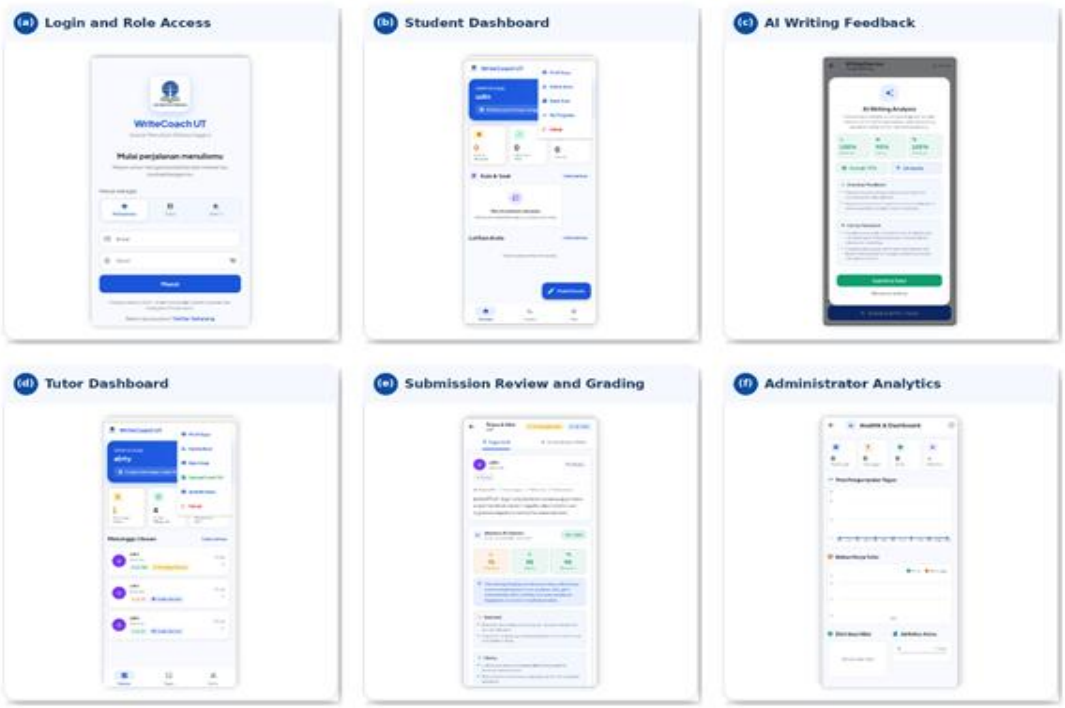

Figure 4. Main user interfaces of the WriteCoach application: (a) login and role access; (b) student dashboard; (c) AI writing feedback; (d) tutor dashboard; (e) submission review and grading; and (f) administrator analytics.

Figure 4 presents the main user interfaces of WriteCoach. The student screens represent access to learning activities and AI feedback. The tutor screens represent submission monitoring and grading activities. The administrator screen represents system-level monitoring and management. These interfaces show that the application follows the role-based design described in the Methods section.

The interface implementation also supports workflow clarity. Students do not access administrative features, tutors do not manage system-level user approval, and administrators do not directly participate in writing assessment. This separation reduces interface complexity and ensures that each user group interacts only with features relevant to its responsibilities.

4.6 Role-Based AI Feedback Testing

Functional testing was conducted using black-box testing to verify whether each role could access and use the features according to its function. In addition to general feature testing, role-based AI feedback testing was conducted to ensure that the AI feedback workflow worked correctly for students and was connected to tutor assessment.

Table 10. Role-based AI feedback testing results

Role	Test scenario	Expected result	Actual result	Status
Student	Student writes a draft and requests AI feedback	System displays grammar, clarity, and structure feedback	Feedback was displayed in the student interface	Passed
Student	Student revises writing after receiving AI feedback	Revised text can be edited before submission	Student was able to revise and submit the final draft	Passed
Student	Student submits revised writing to tutor	Submission is stored and visible to tutor	Tutor could access the submitted writing	Passed
Tutor	Tutor opens student writing submission	Tutor can view submitted student text	Submitted text appeared in tutor dashboard	Passed
Tutor	Tutor provides score and feedback	Grade and tutor feedback are stored	Grade and feedback were saved successfully	Passed

Student	Student views tutor grade and feedback	Student can see score and tutor comments	Grade and feedback appeared in student account	Passed
Administrator	Administrator manages student and tutor accounts	User role and access are controlled correctly	Role-based access worked according to user type	Passed

Table 10 confirms that the AI feedback function was successfully integrated into the role-based learning workflow. The student could receive AI feedback, revise writing, and submit the final draft. The tutor could access the student submission and provide final assessment. The administrator could manage user access to ensure that each role interacted only with relevant features. These results indicate that the AI feedback feature was not isolated from the learning system but was connected to student revision and tutor assessment.

4.7 Overall Functional Testing Results

The broader functional testing results show that the main features of WriteCoach operated according to the expected outputs. The tested functions included authentication, registration, role-based access, writing exercise, AI feedback, writing submission, quiz activity, tutor grading, question bank management, user management, class management, analytics, and offline cache.

Table 11. Black-box functional testing results of WriteCoach

No.	Tested feature	Test scenario	Expected result	Result
1	Login and role access	User enters valid email and password	User is directed to dashboard according to role	Passed
2	Registration	New user submits registration data	Account is stored and waits for administrator approval	Passed
3	Writing exercise	Student selects an exercise and writes a response	Writing page is displayed and input can be stored	Passed
4	AI feedback	Student requests writing analysis	Grammar, clarity, and structure feedback are displayed	Passed
5	Writing revision	Student edits draft after receiving feedback	Revised writing can be saved before submission	Passed
6	Writing submission	Student submits revised writing to tutor	Submission is stored and visible to tutor	Passed
7	Tutor grading	Tutor provides score and feedback	Grade and feedback are stored and visible to student	Passed
8	Quiz activity	Student completes a quiz	Answers are stored and score is displayed	Passed
9	Question bank and quiz assignment	Tutor creates or uploads questions and assigns quiz	Questions are stored and quiz appears in student account	Passed
10	User and class management	Administrator manages users and classes	User and class data change according to administrator actions	Passed
11	Analytics	Tutor or administrator opens analytics page	Charts and summary data are displayed	Passed
12	Offline cache	Student works without stable internet connection	Student answers are temporarily stored and synchronized later	Passed

Table 11 shows that all tested features produced outputs that matched the expected results. The student-related tests confirmed that writing practice, AI feedback, revision, submission, quizzes, and progress-related functions worked as intended. The tutor-related tests confirmed that question management, submission review, grading, and class analytics were functional. The administrator-related tests confirmed that user approval, class management, and system monitoring were successfully implemented.

4.8 Summary of Results

The results indicate that WriteCoach was successfully implemented as an integrated AI-assisted mobile writing learning prototype. The evidence shows that the application supports a complete pedagogical workflow: students write drafts, receive AI-generated formative feedback, revise their writing, submit final drafts to tutors, receive human assessment, and monitor learning progress.

The results also show that WriteCoach integrates multiple components into one learning environment: mobile access, AI feedback, tutor assessment, role-based access, quiz management, cloud database management, and learning analytics. This integration distinguishes WriteCoach from standalone AI writing correction tools. The AI component provides immediate formative support, while the tutor component provides final assessment and pedagogical judgment.

However, these results should be interpreted as evidence of prototype feasibility and functional readiness, not as evidence of learning effectiveness. This study verifies that the application works according to the expected pedagogical and functional workflow. Future studies should evaluate the usability of WriteCoach, student and tutor perceptions, AI feedback quality, and the effectiveness of the application in improving EFL writing performance and self-regulated learning.

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