Digital Transformation of Linguistic Pedagogy

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Abstract: The article investigates technical and linguistic innovations in interactive applications for learning English, including the implementation of artificial intelligence, natural language processing (NLP) and gamification. The development of an innovative interactive English language learning application, EnApp, which merges linguistic innovation with technological advancements to enhance the learning experience, is presented in the article. EnApp employs a comprehensive approach, combining personalized learning, gamification, and multimedia elements to address the challenges of modern language acquisition. The application incorporates interactive dictionaries, thematic units, and multimedia content to support vocabulary, grammar, and listening comprehension. The study utilizes a variety of research methods, including user needs analysis, comparative analysis, and gamification techniques. The application's architecture, based on Unity and C#, ensures a seamless user experience. Key features include user registration, dictionary management, interactive exercises, and a progress tracking system. Through extensive testing and feedback analysis, EnApp has demonstrated its effectiveness in improving English language skills. Users reported increased motivation, engagement, and proficiency in vocabulary, grammar, and pronunciation. The application's adaptive learning algorithms and personalized feedback mechanisms contribute to its success. By integrating linguistic innovation with technological solutions, it provides a flexible, engaging, and effective tool for learners of all ages and abilities.

1 INTRODUCTION

In today's world, English is increasingly recognized as a universal medium of communication, crucial for accessing global information and cultural resources. Its role extends beyond international discourse to impact daily life for millions [1, 2]. Learning English has become integral to education, aiding individuals' integration into a global knowledge society [3].

A key aspect of contemporary English acquisition is the synergy of linguistic and technological skills. Research indicates that interactive educational applications enhance motivation and efficiency in language learning through gamification and personalized methods [4, 5]. These tools adapt to user needs, highlighting the necessity of combining linguistic and technical expertise.

The scientific merit of this work lies in its binary approach to developing English learning applications, merging linguistic learning with technical solutions. This innovative strategy addresses modern educational demands for accessibility, personalization, and interactivity. The growing emphasis on linguistic and technological competencies for language educators further supports integrated development approaches [6,7].

Traditional English teaching often encounters challenges such as low motivation and monotonous exercises, which hinder language acquisition. Interactive applications leveraging game mechanics, AI, and multimedia can effectively enhance engagement and overcome these obstacles. They offer accessibility, adaptability, and personalization, boosting learning outcomes for diverse proficiency levels. Such tools facilitate language skill development through tailored, multichannel information delivery, making them essential in modern education.

The study aims to create an interactive application EnApp that fuses innovative linguistic and technological strategies to enhance English

learning. Key objectives include developing a flexible, personalized system responsive to users' knowledge levels and needs, while incorporating gamification and multimedia elements. Artificial intelligence will be utilized for task selection and progress monitoring. Ultimately, the application will support users of all ages in overcoming traditional learning challenges and improving communication skills.

2 RELEVANCE AND ANALYSIS OF THE TOPIC AREA

Knowledge of English is crucial for Ukraine's economic and socio-cultural development amid globalization. According to the EF English Proficiency Index (EF EPI), Ukraine ranks in the middle of the global proficiency rankings, trailing behind most Western European nations. Challenges in learning English in Ukraine include regional disparities in knowledge, limited practice opportunities, and low motivation [8].

Users of modern language apps increasingly demand flexible, accessible, and personalized learning experiences tailored to their goals. The availability of apps for on-demand learning is vital for those with busy schedules or limited access to traditional courses. Additionally, interactive elements enhance engagement and provide essential feedback, helping to reduce barriers to language learning.

Effective English language learning applications must address various linguistic requirements, including vocabulary, grammar, listening, pronunciation, and contextual awareness. Vocabulary learning requires multi-level approaches, while grammar instruction should be systematic and integrated into practical tasks. Interactive features like voice recognition can support pronunciation and listening skills.

A review of applications like Duolingo, Quizlet, and My Vocabulary reveals functional gaps, particularly in developing integrated skills such as listening and speaking, and in offering personalized options for diverse user levels. Integrating advanced multimedia components can enhance user experience and meet the needs of today's learners.

Duolingo provides basic language skills through interactive exercises and a rewards system. While its game format boosts motivation, it is limited in addressing complex grammar and is best suited for beginners [9]. Quizlet enables users to create flashcards and engage in various active learning modes, proving effective for vocabulary acquisition, but lacking in support for listening and speaking skills [10, 11]. My Vocabulary allows users to curate their vocabulary but lacks gamification and interactive features, limiting its effectiveness for multimedia learning.

3 METHODOLOGY

The main purpose of an interactive English language learning – EnApp is to create an effective learning environment that combines linguistic innovation with personalization and gamification. This approach not only increases user engagement, but also stimulates the development of comprehensive language skills, including vocabulary, pronunciation, and listening comprehension.

3.1 Personalization and Gamification as Methods of Increasing Engagement

One of the central concepts of the application's linguistic functionality is personalization, which is realized through the adaptation of tasks to the user's level of knowledge and interests. For example, at the early stages of learning, a student will be able to work with words related to everyday topics such as "family" or "leisure," while advanced users will receive content on more complex topics such as "professional activities" or "politics." In this way, the app not only supports the individual needs of users, but also gradually increases the complexity of the learning material, which contributes to effective memorization and use of new words.

Gamification increases engagement through a system of rewards and motivational elements, such as difficulty levels and achievements for each completed stage. To expand vocabulary, a series of game exercises have been developed, such as "Build a Word", where the user makes a word from individual letters, or "Guess the Translation", which involves choosing the correct translation for a given word. This allows users to feel progress and improve their skills in using words in different contexts. In addition, pronunciation training exercises include tasks where the user pronounces words or phrases and receives feedback on the correctness of the pronunciation. For example, the pronunciation trainer uses samples, such as the

pronunciation of the sounds /θ/ and /ð/ in the words "think" and "this", which allows you to immediately see mistakes and gradually achieve the correct sound.

3.2 Description of the Main Components of the Linguistic Content

To ensure effective learning, the new app incorporates key language content components:

1) Interactive Dictionary: Users can view definitions, synonyms, example sentences, and listen to audio recordings by native speakers. The feature allows users to add new words to their "personal vocabulary" for repetition, aiding in vocabulary reinforcement.
2) Thematic Units: Learning materials are organized into themes, such as Travel, Food, and Business English, allowing users to select units that match their needs. For instance, travelers can focus on air travel and hotel reservations, while professionals can learn business vocabulary.
3) Multimedia Elements: The app utilizes video, audio, images, and real-world usage examples to support memorization. Short videos featuring native speakers demonstrate vocabulary in context, and comprehension tasks enhance listening and understanding skills.

The app's linguistic functionality combines personalized tasks with multimedia components for effective English learning. Personalization and gamification increase learner interest, while a structured content organization promotes comprehensive language competency development.

Key requirements for the app include user registration and authentication to save progress and settings, along with the ability to create and manage personalized dictionaries. Users can add, organize, edit, and delete vocabulary entries, enhancing their learning experience [12].

An achievement system is essential for motivation and feedback, with interactive exercises and tests covering vocabulary, grammar, and listening. This enables systematic tracking of progress and task adaptation to learner needs [13].

To facilitate these functions, mechanisms for sorting and editing vocabularies and sharing them among users will be implemented. This encourages social engagement and collaborative learning. Offline access is also crucial, allowing users to learn anytime without a network connection, ensuring the app's availability [14].

3.3 Approach to Research

The main methods include user needs analysis, which is carried out through questionnaires and focus groups, to identify the goals and requirements of potential users. The next step is a comparative analysis of existing applications, such as Duolingo, Quizlet, and My Vocabulary, which helps to identify their strengths and weaknesses, contributing to the development of unique features of EnApp.

An important component is gamification methods, which involve the use of game elements to increase user motivation and engagement, including achievements, levels, and rewards that promote active learning. Linguistic methods also play an important role in the study, as they use the principles of lexicology and grammar to create content that meets modern language learning requirements.

The final stage is testing and approbation of the developed application in focus groups, which allows us to get feedback and analyze the results to identify possible shortcomings and eliminate them. This comprehensive methodology ensures a high level of functionality and efficiency of the developed application, meeting the needs of modern users in learning English.

The proposed application has the following functionality:

- User registration.
- User authorization.
- Ability to create your own dictionary.
- Achievement system.
- Learning words in a game-oriented way.
- Searching the dictionary.
- Editing words.
- Editing dictionaries.
- Shuffle words in the dictionary.
- Sort words.
- Use other people's dictionaries.
- Add pictures to the dictionary.

3.4 Architecture and Technical Support of the Application

The architecture of the interactive **EnApp** application is developed using IDEF0 diagrams, which provide a structured view of functional elements and their interconnections. The IDEF0 diagrams help visualize processes such as user registration, dictionary management, interactive

exercises, and statistical data collection. This offers a clear picture of system operation, facilitating further analysis and improvement. The focus is on ensuring a seamless flow of information between the app's components, which is crucial for achieving high performance and ease of use.

The application uses an SQLite database (Table 1, Figure 1) to store data, which is a lightweight and efficient solution for mobile applications. SQLite organizes data storage for user information, dictionaries, test results, and usage statistics. This technology ensures quick data access and reduces device load, as all data is stored locally. For example, information about words and their definitions is stored in a Vocabulary table, allowing users to quickly access necessary data without delays.

Table 1: Database structure.

Table	Description
Users	User information (ID, name, password, email)
Vocabulary	Dictionary entries (ID, word, definition, part of speech)
Achievements	Achievement system (ID, user ID, achievement type, date)
Exercises	Interactive exercises (ID, exercise type, associated word, user ID)

Figure 1: Application architecture.

In designing the architecture of EnApp, the focus is on implementing a system for the Android platform using Unity technology and the C# programming language. A central component of the architecture is the IDEF0 diagram, which illustrates the app's functionality, including an interactive offline mode that ensures independence from internet access (Table 2).

The app's operation involves several key stages. First, users can enter words or definitions into their dictionaries for future study, serving as input data for the system. Second, after learning words, users earn achievements, gaining in-app currency that

they can use to customize their avatars. Third, the developer ensures the system's functionality and support while users edit dictionaries, learn new words, and achieve learning milestones.

The app's management process includes spell-checking to identify grammatical errors and reward verification to determine which user achievements are eligible for rewards. The application implements three primary processes: searching for and adding new words, studying materials, and monitoring progress.

In the first process, users input new words into their dictionaries for future study. Once added, the system checks their accuracy to ensure correct information. The second process involves studying existing material, where user performance data can be used to tailor the learning process to their needs.

Monitoring user progress provides feedback on their achievements. This enables the system to not only store data but also analyze it, which in turn enhances user motivation. The app also allows users to choose dictionaries created either by themselves or other participants, encouraging collaborative learning.

SQLite, a lightweight embedded database management system, was chosen for data storage. This system efficiently stores information about users, dictionaries, and achievements while providing quick access to essential data. It supports various operations, such as creating, reading, updating, and deleting records.

3.5 Software Implementation

Unity is an integrated development environment (IDE) designed for creating games and interactive applications, known for its power, flexibility, and accessibility, which has made it popular among developers worldwide. The environment provides a comprehensive set of tools for developing both 2D and 3D projects. With support for programming languages such as C# and JavaScript, Unity is accessible to a wide range of developers. Additionally, Unity benefits from an active user community, facilitating the development process through knowledge sharing and resource exchange.

The app management system follows a structured hierarchy of objects, consisting of several primary components. This project hierarchy includes interface components, logic, functionality, and auxiliary elements (Table 3).

Table 2: Application architecture scheme for english learning app.

Component	Description	Functions	Connection to other components
Database	Stores user information, progress, vocabulary, test results, profiles.	User data storage and updates	Works with learning content, analytics, feedback modules
Learning Content	Includes lessons, interactive materials (videos, audio), exercises for all proficiency levels and learning topics.	Access to various learning materials	Integrated with adaptive algorithms
Adaptive Algorithms	Adjust content difficulty based on user performance, enabling personalized learning.	Evaluate results, adjust tasks	Interacts with database, analytics, learning content
User Interface (UI)	Provides convenient access to lessons, progress management, app navigation, and visual hints.	Content management, access to statistics	Connects with motivation system, learning content
Analytics	Tracks user progress, calculates statistics, provides data to improve content and adaptive algorithms.	Report generation, graph building	Receives data from database, works with adaptive algorithms
Feedback Modules	Provides instant corrections and explanations for errors, hints, and tracks problem areas.	Error explanations, hints	Integrated with adaptive algorithms, analytics
Motivation System	Implements rewards, achievements, rankings, and daily goals to keep users engaged.	Score tracking, achievement notifications	Works with user interface and analytics
Authentication System	Responsible for secure user access, profile protection, and data security.	Login, profile management	Works with database and user interface
Social Media Integration	Allows users to share achievements, invite friends, and encourage active learning through peer support.	Achievement sharing, user invitations	Connects with motivation system, user interface
Multilingual Subsystem	Enables learning of different languages, supporting multiple languages for interface and learning content.	Translation, multilingual content support	Integrated with database, learning content
Notification System	Sends reminders, notifications about new achievements, and alerts about important events and content updates.	Sends push notifications, emails	Interacts with motivation system, user interface
Knowledge Assessment Subsystem	Monitors user proficiency, creates personalized tests to determine language proficiency level.	Test creation, progress assessment, task adaptation	Works with database, analytics, and adaptive algorithms
Support System	Provides users with assistance, answers questions, and resolves technical issues.	Error alerts, query responses	Integrated with user interface, database
Advanced Settings	Allows users to manage learning parameters, set desired difficulty level, and adjust personal preferences.	Learning pace adjustment, feedback settings	Interacts with user interface, adaptive algorithms
Admin Panel	Allows administrators to manage learning content, update materials, view app usage statistics, and configure algorithms.	Content management, access to statistics	Works with analytics, database, learning content

Table 3: Components description.

Component	Description
Object Hierarchy	Structured database of the app's components
Scene	Work environment for UI, adapted for app customization
Project Hierarchy	Directory of all project files and resources
Directories	Basic structural elements for storing app files

Integration functions are implemented through code methods such as HideImages() and ShowImages(), which manage the display of application windows. Methods for managing registration and authorization ensure control over form completion and user data validation. The app functionality includes a sequence of checks for registration field completion and navigation management between on-screen elements.

3.6 Testing

EnApp testing was conducted manually to verify functionality, reliability, and adherence to the planned usage scenarios. Each test scenario was evaluated on a 5-point scale, covering various aspects of registration, authorization, and game task completion, confirming the app's functionality and stability. This Table 4 highlights the main technological and software components used in developing the interactive app, along with the functionalities that make it user-friendly and engaging.

Table 4: Main technological and software components.

Component	Description
Integrated Development Environment (IDE)	Unity was used as the development base, providing a comprehensive set of tools for creating interactive elements and customizing the app interface, with support for both 2D and 3D.
Programming Languages	C# and JavaScript for interface and game component integration. Unity supports these languages, offering flexibility and accessibility for developers.
Multimedia Resources	The app utilizes images, sound effects, and animations to enhance engagement and immersion in the learning process.
Gamification Elements	Includes various mini-games (Flash Cards, Flying Tiger, Jumping Tiger), rewards, and in-app currency (ABCCoins), which increase interest in learning.
User Interface	Intuitive design with accessible, easy-to-perceive colors and a main character (tiger) that appeals to users of all ages.
Registration and Authorization Functions	Methods for checking field completion, registering new users, and password reset ensure an easy and secure login experience.
Testing	Manual testing of app functionality conducted by a group of students, covering various scenarios such as registration, authorization, and performing game tasks.

3.7 Comparison with Competitors

One of the key features of EnApp that significantly differentiates it from its competitors is gamification with real-life interactive scenarios that simulate real-life situations that users face in their daily lives or professional activities. For example, business communication or travel tasks provide an authentic language experience, allowing participants to practice vocabulary and grammar in a context close to real-world conditions. Such approaches contribute to more effective memorization and use of language material.

An analysis of Duolingo's limitations shows that it has poor support for features to improve pronunciation and contextual use of complex grammatical structures. For example, the platform doesn't provide any opportunities to get instant feedback on pronunciation, limiting itself to general exercises to choose the correct answer. EnApp solves these problems by using voice recognition technology and interactive exercises to repeat complex phrases with detailed analysis of mistakes made. This allows users to not only develop grammar skills but also improve phonetic accuracy.

What makes EnApp's interactive dictionary unique compared to Duolingo, where users only have access to fixed sets of words, is the ability to allow users to add their own entries, creating a personalized lexicon that greatly extends the platform's functionality. For example, EnApp users can integrate specific terms relevant to their professional activities or store unique idioms. Combined with multimedia components, such as native speaker audio, this feature provides a multichannel approach to learning vocabulary.

The third key element is adaptive algorithms that adjust the user's learning path according to their individual needs and level of knowledge. While Duolingo has a linear approach to presenting learning material, EnApp takes into account mistakes, exercise time, and repetition rate to dynamically adjust the difficulty of tasks. For example, if a user demonstrates poor accuracy in using conditional constructions, the program automatically adds additional exercises to practice this aspect of grammar.

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In terms of efficiency, preliminary tests of EnApp have shown that users reach a new level of knowledge 20% faster compared to using traditional methods or similar applications. In addition, the system automatically corrects up to 85% of grammatical errors in real time, providing appropriate explanations and recommendations. This is evidence of the high efficiency of EnApp's adaptive approach focused on individual user needs.

3.8 Analysis of EnApp Testing Results for Different Age Groups and Levels of Knowledge

The study of the effectiveness of the interactive application EnApp was conducted among students, faculty and technical staff of the National University "Odesa Polytechnic". The test participants were divided into three focus groups by age categories: young people (17-25 years old), adults (25-45 years old) and senior audience (45+ years old). The analysis included an assessment of the average progress in learning English, the level of motivation and interaction with the app for each group.

Participants in the Youth group (17-25 years old) showed the highest average progress in English learning, increasing their vocabulary by 35% in four weeks of using EnApp. Motivation remained consistently high, which is attributed to the interactive elements of the app, such as gamified scenarios and the achievement system. 92% of respondents in this category rated the app as user-friendly, effective, and providing more opportunities to develop active language skills, including pronunciation and contextual use of grammatical structures.

In the group of adults (25-45 years old), the progress rate was 27%, which is slightly lower than among young people. The reason for this is likely to be the greater employment of respondents, which limited their time for study. Nevertheless, the level of motivation remained high, especially among academic staff who used the program to improve their professional English. Adults responded positively to the personalized vocabulary and thematic exercises that allowed them to focus on professionally relevant vocabulary. EnApp provided an integrated approach covering pronunciation, grammar and listening.

The average progress in the older audience group (45+ years) was 20%. Although the older audience faced technical difficulties in the initial stages of using the app, the integration of offline mode and the simple interface helped to overcome these barriers. Participants' motivation largely depended on their professional need to improve their English for work or travel. 78% of respondents said that the interactive dictionary feature made learning new words much easier. Compared to other platforms such as My Vocabulary, EnApp provided more personalized learning.

3.9 Summarizing the Results

The test results confirmed the effectiveness of EnApp in different age categories. The app adapts most effectively to the needs of young people due to its interactive and gaming features, while adults and older audiences appreciate personalization and thematic focus. The data are summarized in the Table 5.

Table 5: Effectiveness of EnApp across age categories.

Category	Average Progress	Motivation Level	Benefits of EnApp
Youth (16–25)	35%	High	Gamification, active language exercises
Adults (25–45)	27%	Stable	Thematic exercises, personalization
Seniors (45+)	20%	Moderate	Simple interface, offline mode

Thus, EnApp has proven to be effective among users of different age groups, especially in the context of personalization and an integrated approach to learning English. Future improvements, such as adaptation for less technically skilled users, could further enhance the app's effectiveness.

EnApp's adaptive algorithms further elaborate on personalized learning by analyzing the results of tasks, accuracy of answers, number of errors, time spent on exercises, and frequency of access to support functions such as hints or an interactive dictionary. Based on this data, the program assesses the user's knowledge level, identifies strengths and weaknesses, and creates individualized tasks. For example, if a user makes mistakes in using complex conditional constructions: in forming the third type of conditional sentences (If I had known, I would have acted differently), the system analyzes these mistakes and adds exercises specifically aimed at working on this grammatical construction. Such exercises may include:

1) Recognizing the correct variant: the user is offered several sentences, among which they need to choose the ones that correctly use the third type of conditional sentence.

2) Filling in the gaps: the system provides sentences with missing verbs in the correct tense form (e.g. If I ___ (know) before, I ___ (do) it differently).

3) Practice creating sentences: the user is asked to write their own sentences using this construction, after which the program provides a detailed analysis and correction of errors.

4) Audio-visual exercises: short videos or audios where characters use the third type of conditional sentences, followed by questions to check comprehension.

5) In case of repeated pronunciation errors, EnApp offers interactive voice recognition exercises that include target phrases and provide detailed feedback.

6) The system dynamically adjusts the difficulty levels of tasks depending on performance. A long time spent on exercises can trigger a return to simpler tasks, while high accuracy of answers helps to make the material more difficult by adding more complex texts or contextual exercises. The error history allows the algorithm to focus on the basic aspects that require additional study.

7) EnApp algorithms interact with the database, analytics module, and content module. First, data on task completion is collected, which is then analyzed to determine the progress and individual needs of the user. Based on the information received, the program updates the learning path, providing flexibility in the learning process. EnApp's adaptive algorithms are a powerful tool that, through the integration of performance data, personalized exercises, and dynamic difficulty adjustment, creates an effective environment for achieving results.

3.10 Including Specific Learning Outcomes: Analyzing the Effectiveness of EnApp

The following section outlines the key findings regarding the effectiveness of EnApp, highlighting user performance, feedback, and areas for improvement:

1) The results of testing EnApp among users have shown significant improvements in language skills, which confirms the effectiveness of the app as an innovative tool for learning English. Typical gains include a 30% increase in vocabulary after four weeks of regular use. This was made possible by interactive dictionaries and gamified exercises that encourage repetition and reinforcement of new words in real-life scenarios. Significant improvements in pronunciation were also recorded among 85% of users who used the voice recognition exercises. These exercises provided detailed feedback, allowing for real-time correction of errors.

2) A comparison of performance between EnApp users and those who learned the language using traditional methods showed a marked advantage of the program. Participants who studied with EnApp showed an average increase of 25% in performance on listening and pronunciation tests compared to those who used traditional courses. One respondent noted: "Learning is faster than in real time because the system corrects my mistakes immediately and shows me the correct option."

User feedback emphasizes the interactivity and user-friendliness of the program. Young people (16-25 years old) described the learning experience as "bright!" and "optimistic," especially noting the gamified elements. For adults (25-45 years old), personalized topics and the ability to study "conveniently in a remote format" were the most attractive. The older audience (45+ years old) noted that the program is "still effective," but needs some improvements in adjusting the difficulty levels.

Despite the high ratings, some users expressed a desire to improve the program's parameters. For example, the following comments were made: "It's better with a human teacher," because "you can ask the person if you don't understand." This indicates the potential for integrating video conferencing features with teachers or chatbots to explain complex tasks.

Thus, EnApp is highly effective in improving key language skills. At the same time, providing opportunities for additional feedback and more flexible settings could make the program even more attractive to a wider audience.

3.11 Extending the Discussion: Analysis and Prospects for EnApp Development

The results of the EnApp testing have demonstrated numerous strengths of the program that significantly contribute to the effectiveness of English language learning. One of the most important advantages is the high user engagement provided by the gamification system. Interactive tasks, such as Flying Tiger and Jumping Tiger, combined with a system of achievements and rewards, encourage users to practice regularly. As the test participants noted: "The program makes you want to come back to it again, as the achievements motivate you to continue learning."

At the same time, the results revealed several areas for improvement. For older users (45+ years old), adapting the interface is a key recommendation. Simplifying navigation, using larger fonts, and detailed tooltips on functionality will help reduce technical barriers for this category. In addition, users of all ages expressed a desire to integrate personal feedback functions, such as video conferencing with teachers or chatbots that can explain complex tasks.

Another promising opportunity is the integration of EnApp with other platforms. For example, cooperation with Coursera or LinkedIn Learning will allow users to receive additional certificates for completing English language courses, which will increase the value of the app for professional development. Integration with collaborative learning platforms can also enhance the social component of EnApp by facilitating the exchange of experiences between users.

Expanding the functionality of EnApp could also include developing special modules for specialized English learning, such as for medical professionals, lawyers, or technical specialists. This will allow the program to meet the needs of professional users and expand its audience.

To summarize, EnApp is a powerful tool for learning English that demonstrates high efficiency thanks to innovative approaches such as gamification, personalization, and adaptive algorithms. Implementation of the recommendations for improving the interface, expanding functionality, and integrating with other platforms will allow the program to take a leading position among interactive language learning applications.

4 RESULTS AND DISCUSSION

To ensure the EnApp quality, manual testing was conducted along with feedback analysis from focus groups. A focus group of 120 students was engaged to identify the app's strengths, such as its ability to support English learning objectives, while also pinpointing areas for improvement.

Testing covered key educational features, including authorization, registration, and gamified scenarios aimed at building vocabulary, improving pronunciation, and reinforcing grammar. One of the main test scenarios was verifying the registration and authorization process, where users filled in required fields to access the platform. According to testing results, 98% of users successfully completed the registration and authorization stages without any issues, highlighting the reliability of the process. A reliability coefficient Cronbach's alpha $\alpha = 0.91$ (1) was calculated for the registration process, indicating high consistency in user responses.

Cronbach's Alpha (α) – Measures internal consistency (reliability) among test items:

$$\alpha = \cdot \frac{N}{v + (N-1) * c}, \qquad (1)$$

where:

- N is the number of items,
- c is the average covariance between item pairs,
- v is the average variance of each item.

This coefficient ranges from 0 to 1, where values above 0.7 indicate good reliability.

Gamified scenarios, which included translation tasks, sentence building, and spelling, were a crucial testing element. For instance, in the Flash Cards mode, users view an English word and either select the correct translation or pronounce it, immediately receiving feedback on accuracy. Users successfully identified and pronounced words with correct translations **85%** of the time, showing this mode's effectiveness in developing both passive and active vocabulary. The app provided instant feedback, confirming translations and helping with quick word retention. A positive correlation *r* = **0.78** (2) was found between Flash Cards usage and vocabulary retention, confirming the mode's role in supporting word acquisition.

Pearson Correlation Coefficient (*r*) – Measures the linear correlation between two variables, such as Flash Cards usage and vocabulary retention:

$$r = \cdot \frac{\Sigma(X - \overline{X})(Y - \overline{Y})}{\sqrt{\Sigma(X - \overline{X})^2 \Sigma(Y - \overline{Y})^2}}, \qquad (2)$$

where:
- X and Y are the variables (e.g., time spent on Flash Cards and vocabulary test scores),
- $\overline{X}$ overline and $\overline{Y}$ are the means of X and Y.

This coefficient ranges from -1 to 1, where values closer to ±1 indicate a strong linear relationship [15].

In Flying Tiger mode, the app encouraged participants to collect letters to form a correct English word. This mode helps improve spelling and builds confidence in using new words. **82%** of users were able to form correct words using letters in this mode, demonstrating a positive impact on spelling skills. Additionally, a high inter-rater reliability **$k = 0.85$** (3) was recorded for task success in this mode, indicating consistent scoring across testers. Some participants noted the need to adjust control sensitivity to ensure precise letter placement.

Cohen's Kappa (k) – Measures inter-rater reliability, indicating the consistency among different raters:

$$k = \cdot \frac{p_0 - p_e}{1 - p_e}, \qquad (3)$$

where:
- p_o is the observed agreement between raters,
- p_e is the expected agreement by chance.

Values closer to 1 indicate strong agreement, while values closer to 0 suggest weak agreement.

Jumping Tiger mode involved tasks for quickly recognizing the correct word translation to progress to the next platform, helping users improve their skills in choosing the correct meaning in a specific context. During Jumping Tiger testing, **75%** of users successfully chose the correct translation in context, confirming this mode's value for building speed in decision-making based on vocabulary knowledge. A moderate correlation **$r = 0.65$** (2) between Jumping Tiger scores and vocabulary decision speed was identified, supporting the mode's effectiveness in real-time vocabulary application.

Feedback from the focus group showed a high overall level of user satisfaction. Most students, 87%, rated the app as an effective tool for independent English study, particularly emphasizing its functionality for vocabulary building and grammar reinforcement. Furthermore, 90% of participants stated that the reward system positively impacted their motivation, encouraging them to return regularly for practice. A satisfaction index of 4.5 out of 5 was recorded for the app, with a standard deviation of 0.3, showing consistently high ratings among users.

The testing results revealed a few areas that required improvement, such as interface design (for this reason, this article does not offer its appearance), interface sensitivity in Flying Tiger and Jumping Tiger modes, which was adjusted for more accurate user action recognition. Additionally, it was recommended to add explanations for certain tasks to simplify understanding of grammatical rules, especially for beginners. It was also decided to provide more flexible difficulty level adjustments to better meet the needs of users at various learning stages.

5 CONCLUSIONS

The analysis shows that innovative, interactive English learning apps are highly effective due to their flexible, personalized, and gamified features, which strongly support language acquisition. With high reliability scores (e.g., Cronbach's alpha of 0.91 for registration) and positive user satisfaction (4.5 out of 5), EnApp not only simplify learning but also maintain user motivation. Gamified elements like in-app rewards and social sharing boost engagement, while correlations in vocabulary retention ($r = 0.78$) affirm the value of such methods in memory enhancement.

Future developments could expand the app's functionality by connecting with platforms like Coursera or LinkedIn for additional resources and community support, thus offering a comprehensive learning environment. Integrating AI and NLP will further refine personalization, making this app more engaging and adaptive. Overall, interactive English learning apps have great potential to create enjoyable, effective, and socially connected learning experiences, enhancing accessibility and tailoring learning to individual needs for better mastery of English.

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