

Personalized Mobile Learning System to Enhance Language Learning Outcomes

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Abstract

Objectives: This study describes the development and evaluation of a personalized mobile language learning system to teach and improve spelling. **Methods/Statistical Analysis:** The design process consisted of two stages: the first was directed by needs analysis sessions with a focus group of 5 language teachers. Next was analyzing the data collected during the previous phase and applied it to system design. It consists of: a practical component in which a learner can practice a specific spelling rule, and a game component where a learner plays a spelling game and scores her progress. **Findings:** The system adopts a personalized design approach allowing the instructor, or the parent, to add new spelling rules or new spelling words, which will be automatically embedded into both the practical and game components. The evaluation process involved testing the system on young students in classroom and home settings. Data were collected through observation and interview. Results indicated an overall positive attitude towards using the system. This study hopes to open a channel of communication that will facilitate development of systems that enhance learning outcomes among young learners using mobile gaming technology. **Applications:** Mobile application, Personalized android app.

Keywords: Gasification, Language Teaching, Mobile Assisted Language Learning, Personalized Language Learning, Spelling

1. Introduction

Traditional instructional methods, which rely on the same instructor present the same material to different students, are no longer acceptable. This is because students learn at different paces and possess different levels of existing knowledge and experience. Such teacher-centered instructional methods have lost favor to more student-centered and task-based approaches to learning that focus on students' individual needs and autonomous learning styles. In recent years, the use of technology in the classroom has enriched the learning process, providing students with more interactive, multisensory, and hands-on learning experiences. One of the major affordances of today's technology is the enhancement of the concept of personalized learning¹.

Personalization can be defined as the integration of modern technology into the individual learning styles of

student. It is not the transformation of traditional learning materials into a digital form. Rather, personalization is the combination of modern technology and teacher input applied to the distinct learning requirements of individual students. Moreover, personalization can provide data about each student's learning strategies to the teacher. The teacher may then use these data as the basis of pedagogical decisions to improve student engagement using methods and paces tailored to each student¹. Personalization attempts to adjust the learning material according to the needs of individual students and moves away from "one-class-fits-all" instructional approaches.

With the personalization approach, students are granted the freedom to study at their own pace and in their own style. This independence can motivate students to invest more time and effort in studying and improving their unique skills. Students, especially young children, tend to be more motivated by teaching styles

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that are collaborative, relevant, and engaging¹. The present study describes the development and evaluation of a personalized mobile system, Afaneen that attempts to enhance both the teaching and learning processes concerning spelling. This study is hoped to bridge the gap between educators and App developers through conducting a needs' analysis to gather data about the system requirements and how such game can be used to enhance learning outcomes among young learners.

The remainder of this paper is organized as follows: Presents a that explores two areas: mobile learning and personalization systems. System Design and System Implementation report on the materials and methods of this study. The experiment is presented in the Evaluation Procedures section. The Conclusion ends this paper with a discussion of our future work.

Mobile learning has gained increasing attention from researchers over the past few decades. Recent enhancements in mobile technology and capabilities have dramatically increased the interest in educational uses, especially among language instructors. Several studies have investigated applications of mobile technology to improve language learning²⁻⁵. However, traditional instructional approaches still dominate language learning classrooms⁶⁻⁷. The author argues that the issue is no longer related to "hardware/software shortcomings"; rather, to a true lack of "conceptualization of how language learning could be enhanced in new, innovative ways with the assistance of mobile devices"⁶.

Mobile games present one of the most common implementations of mobile learning, as mobile games are highly appealing to young users. A quick search in a web-based mobile application store shows a considerable number of mobile games intended to enhance language abilities. According to Chen, the purpose of a language game is to "use the language". These games try to encourage the players to use the language properly in a motivating environment, aiming at increasing players' productive and accessible language skills⁸. Educational mobile apps are becoming very popular among students due to the ubiquity and portability of the platform and technology⁹. Learning via mobile games allows students to acquire knowledge through trial and error, enabling the learner to change their behavior based on their individual learning curve. In this scenario, players feel comfortable making mistakes and therefore make more attempts to determine the correct answers. These games are appropriate

for several language learning skills including: vocabulary, spelling, listening, speaking and reading¹⁰.

Several research projects have addressed issues related to educational game design and evaluation. In their 2008 study, they designed a personalized mobile English vocabulary learning system based on item response theory and learning memory cycle. Their system consisted of a remote management server, a client mobile learning system, and data synchronized agent. The system recommends vocabulary with an appropriate difficulty level according to the individual abilities of the learners. The experimental results reveal that the review strategy used by the proposed system is highly effective. Furthermore, the system provided a ubiquitous learning environment that was not constrained by time or location¹¹.

In 2010, the authors investigated the impact of ubiquitous games on learning outcomes as well as on student motivation regarding English listening and speaking. The researchers used a context-aware ubiquitous learning environment called the Handheld English Language Learning Organization (HELLO). Results showed that the use of ubiquitous games in learning improved learning outcomes compared to non-gaming methods¹².

The authors developed a game-based English vocabulary learning system implemented as e-books. Through experimental evaluation, they demonstrated that their interactive e-book game design increased user motivation and engagement in English language learning. The researchers argue that the real-time learning tools and related assistant functions effectively enhanced users' English language reading skills, thereby increasing the overall efficacy of students' English learning endeavors¹³.

In another study, the authors developed an English vocabulary app that improved players' English language skills. The game provides definitions and asks the players to identify the defined word. The game reinterprets paper-based crossword puzzles as a mobile app in which the user interface is a crossword grid. From a pedagogical perspective, the game enables players to review vocabulary and definitions to reinforce the process of learning of new words. To motivate players and facilitate their acquisition of a precise vocabulary, the game rewards correct answers as the player progresses through levels of difficulty. The researchers credit the game's learning efficacy to "frequent repetitions of learning activities"¹⁰.

In 2017, the authors developed a mobile game-based English vocabulary practice system that comprised of

word selection activities, a difficulty ratio, and learning portfolios. To evaluate the game, an experiment conducted on three groups tested different vocabulary review methods. Results indicated that students who used the proposed system demonstrated higher interest, attention, and learning effectiveness, and experienced a sense of accomplishment and triumph¹⁴.

Few studies have addressed the use of mobile games to enhance spelling. However, the authors conducted a study on the impact of a computer-based literacy game, GraphoGame™, on the literacy skills of first grade students in an African city (2014). Control and intervention groups were created by randomly sampling 573 first grade students. The game was administered on cell phones to students in supervised classroom settings. Its performance was then assessed using an orthography test, a spelling test, a Picture Vocabulary Test (PVT), and the Zambia Achievement Test. The intervention groups exhibited substantial improvement in their spelling test scores¹⁵.

In another recent study, the authors investigated the effects of educational games on learning English spelling among Iranian children. Study participants were consisted of 66 Iranian students of the English language with an average age of 9.5 years. The participants were randomly assigned to one of two groups. For one entire term, the experimental group exposed the students to an educational computerized game called “Fun Spelling,” while the control group completed homework in the conventional manner. English spelling tests, dictation tests of homophones, and dictation tests of English words with silent letters, were used to assess participants before and after the experiment period. The results revealed that the educational game had a considerable beneficial impact on the language learners in the experimental group. The experimental group demonstrated improved abilities in all three areas tested, particularly in their understanding of homophones and silent letters in the English language¹⁶. Most of the studies on mobile educational games have demonstrated increased student motivation and improved learning outcomes. Mobile games allow students to learn in fun and interactive environments. The use of mobile educational games has another interesting aspect which is inherent to mobile games, that is the variety of content, design, and player modes.

Despite the affordability, ubiquity, and multi-functionality of mobiles, some argue that most of the available educational games “still support a mainly one-way interac-

tion (teacher to learner or computer-client interaction)”¹⁷. Many educational mobile games fail to support adaptive learning scenarios that would enable personalized content according to individual needs of learners. Therefore, this paper proposes a personalized mobile system that attempts to improve spelling.

2. Methodology and System Design

This section describes the system design process for a personalized mobile game to improve spelling. The design process adopts the user-centered design cycle approach depicted in Figure 1. The design occurred over several stages. First, a needs analysis was conducted to identify the initial system requirements. Feedback was collected from a focus group of experienced teachers. The first version of the game was designed and uploaded to Google Play. Five elementary school teachers were then asked to evaluate the system in-classroom with their students and provide feedback and suggestions for improvement. The primary objective of this phase was to obtain teacher input on potential system enhancements.

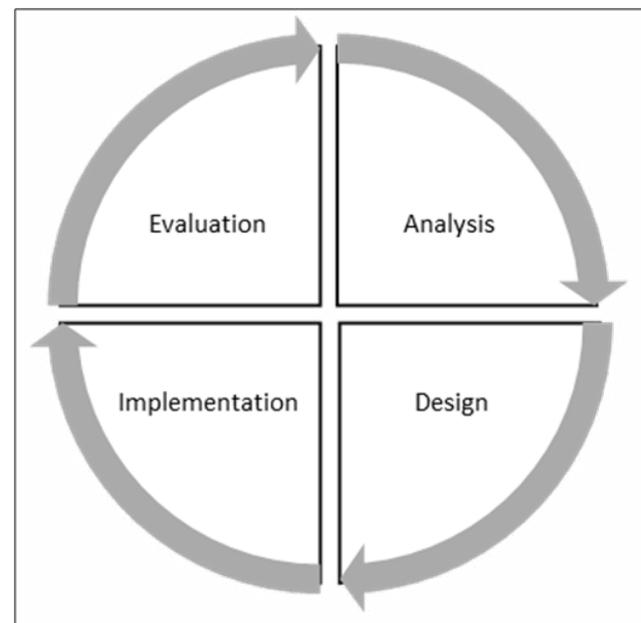


Figure 1. User-Center Design Cycle.

Suggestions and feedback gathered during the evaluation process helped identify some limitations in the first version of the game. Based on teacher feedback, the system was modified to include two components: a practical

section and a play section. In the practical section, a list of spelling rules is displayed for the user to choose from. The fundamental spelling rules, which must be acquired by children in the first three grades of elementary school, were uploaded into the system as the default rules. Each rule is supplemented with five example words. The system was also enhanced to be more personalized, account the individual needs of students and corresponding to their different learning levels. Thus, the teacher or parent may add new spelling rules with a minimum of five example words and record their voice. The teacher/parent can also add new words to an existing spelling rule. The new words and/or the new spelling rules are stored and immediately added to the play section. Hearing the voice of their parent/teacher is hoped to motivate the child and enhance their engagement and willingness to continue practicing. New words and rules can be added or deleted according to the learner’s level or at any arbitrary point.

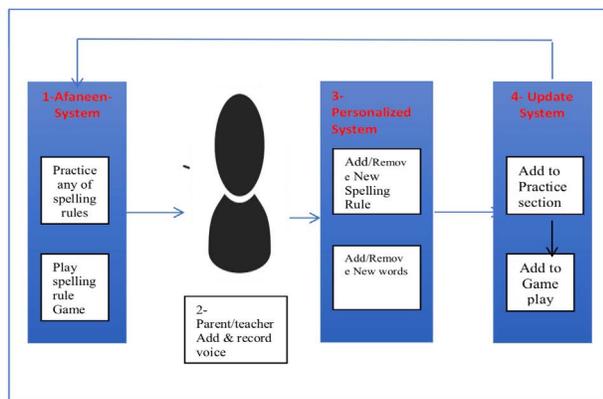


Figure 2. Personalized system.

The second part of the system involves a spelling game. The game was constructed to progress from easy to more advanced spelling rules. For each spelling rule, the user is asked to spell five words correctly in order to move to the next level. Each rule tests 15 words selected from the elementary school’s language textbooks. These words were provided by teachers and assistants. In addition, words may be added or deleted as explained previously. Immediate positive feedback is provided when the student answers correctly: a clapping sound plays and the player is awarded a point. Then the game continues with a new word. The player is not allowed to move to the next level until they consecutively spell five words correctly. The players are provided with three chances to provide the correct spelling of a given word. If all three attempts

are unsuccessful, the correct spelling is displayed and a new word is presented. This process is repeated until the player consecutively spells five words correctly to move to the next level. Figure 2 illustrates the learning process implemented by Afaneen.

3. System Implementation

We adopted the following tools to implement the system: Android Studio Integrated Development Environment (IDE) for Android application development, the Java programming language, and a SQLite database. The implementation involved three components: the main user interface, the practical interface, and the game interface.

3.1 Main User Interface

The main User Interface (UI) displays simple, applies a consistent color scheme, and contains a canvas object that contains and controls the most important UI elements. It holds the main menu options, which are Practice, Statistics, Contact Us, and Previous Mistakes, and the primary button which starts the game. Figure 3 displays the main user interface of the Afaneen System and numbers elements of the display.



Figure 3. Main user interface of the Afaneen system.

After starting the system, the player presses the start button: (5) for game section or presses the practice button (1). If the user is a returning player, they may check their game statistics (2), including their point-based score, number of mistakes. Returning players may also review their previous mistakes and determine their spelling accuracy (4). Players may contact us (3), the game developers, or read about the system and the developers (6).

3.2 System Level Interface (Game)

The Afaneen System consists of a practical component and a game component. Although the system was designed for the Arabic language, it is language independent and can be applied in any language. Figure 4 shows one level of the game interface. The numbers next to each object correspond to the following list of interface functionalities.

1. The Pause button allows the player to pause the game so that they can complete it at another time. The user's session is saved and restored when the player resumes the game,
2. The Text button writes the selected Arabic letter in a cursive manner and connects it with other letters to display a word,
3. The Quit button allows the player to end and exit the game,
4. The Timer is displayed as clock that shows the remaining time in which the player can enter the letters of pronounced words,
5. The player uses this section of the display to select letters that spell the pronounced word. The available letters include extra letters that are chosen specifically for each spelling rule to confuse the player and make the game more challenging. There are usually four extra letters chosen for their similarity to the correct letters,
6. Pressing the Help button produces a pop-up window that shows the definitions of the associated spelling rule to aid selection of the appropriate letters,
7. Selecting this icon repeats the pronounced word,
8. This button removes one letter from the display to help the player choose the correct letters. This feature is only available if the player has already collected points in previous levels,
9. Pressing this icon clears the last letter,
10. The Submit button enters the player's answer into the system, and

11. This pop-up message, in Figure 4(b), indicates if the submitted word is correct or erroneous.



Figure 4. Afaneen spelling page: (a) At start; (b) After selecting the correct letters of the pronounced word

3.2.1 Spelling Rules, Previous Mistakes, and Statistics Interfaces (Game)

Figure 5 shows the game interfaces for the spelling rules, previous mistakes, and player statistics. Each screen is numbered for clarification purposes. The numbers in Figure 5(a) correspond to the following features:

1. The Close icon returns the player to the game page, and
2. This button presents the definition of the spelling rule for the current level to aid the player in remembering the rule and selecting the appropriate letters for the spoken word.



Figure 5. Game interfaces: (a) Spelling rules; (b) Previous mistakes. (c) Game statistics.

Next, Figure 5(b) shows the screen that displays the player’s previous mistakes. We expect this screen to help players to remember and understand their mistakes so that they can overcome the learning obstacle.

1. The Home button brings the player back to the primary user interface, seen in Figure 3,
2. The red circle marked with an “X” indicates an erroneous word entered by the player,
3. The green circle with a check mark indicates an accurately spelled word, and
4. Displays the definition of the spelling rule, which explains the player’s mistake.

Finally, Figure(c) consists of the following features related to player statistics.

1. The Home button,
2. This item indicates how many times the user has played the game with a count of incorrect answers,
3. This item counts the number of wins, that is, the number of times the player correctly spelled the pronounced word,
4. This item counts the player’s losses,
5. This item indicates the player’s total points as collected coins. Points are earned by accurately spelling words within the time specified for each level and in the first attempt, and

The reset button allows the player to reset the statistics page so that they may restart the game.

Afaneen displays spelling rule definitions on more than one page, in order to show enhance rule comprehension and improve the player’s spelling proficiency.

3.3 System Level Interface (Practical and Personalized)

As mentioned previously, the Afaneen System consists of a practical component and a game component. Figure 6 depicts the practical interface. Figure 6(a) represents the fundamental spelling levels derived from the focus group. The user can press any rule and practice before starting the game. Figure 6(b) presents an individual rule with two buttons: one button for practice and one button to add a new word. Figure 6(c) shows that if the user scrolls through all the levels in Figure 6(a), the teacher/parent may add a new spelling rule to the mobile device. By

allowing users to add new spelling rules, the system is not constrained to the fundamental rules determined during development. The idea is to offer personalized levels of increasing difficulty levels so that the player does not lose interest when they have mastered the initial levels. This option will make Afaneen more appealing to teachers and parents. As the child masters basic spelling rules, they can move to more advanced levels as their teacher/parent adds new spelling rules.



Figure 6. Practical interface: (a) Practice levels; (b) Practice or add a word; (c) Add new spelling rule.

3.4 Adding New Spelling Rules and New Words

Figure 7 shows the interfaces for adding a new spelling rule and its corresponding words. We added an option to control the size of the Afaneen System in the mobile device and that avoids excessive device memory consumption by limiting the addition of new spelling rules or new words. The system is designed so that after the child practices, plays and masters newly added spelling rules, the teacher/parent has the option of deleting the content and adding new spelling rules. This was designed to facilitate system management on mobiles with memory constraints. This feature is intended to encourage the teacher/parent to continue using the system over time.

Figure 7(a) is typing screen for a new spelling rule. If the parent/teacher presses Add button, then the Figure 7(b) screen appears. Then parent/teacher needs to name the spelling rule and enter the rule description and the confusing letters that will be used to increase the game’s challenge. This screen also requests that the parent to record themselves speaking new spelling rule. Upon completion, the new spelling rule appears in the practice levels and the newly added rule option is moved to the left. The system further requires that a minimum of

five words be added with each new rule so that the player can practice the rule. Without these five words, the rule will not function. To accomplish this task, the parent/teacher presses the rule's icon and then presses the Add Word button. Figure 7(c) shows the screen for writing and recording new words to be associated with the new spelling rule. Once the word is added successfully, Figure 7(d) shows the pop-up message that appears at bottom of the screen confirming that the word is attached to the newly spelling rule.



Figure 7. Interface for adding new spelling rules and words: (a) Typing a new spelling rule; (b) Added new spelling rules to the list; (c) Adding words for new spelling rule; (d) Message at the bottom of the screen displays the added words.

4. Evaluation Procedures

In this section, details regarding the evaluation process are presented. Our objective was to ensure that the application meets all the system and user requirements. Two evaluation approaches were applied: a holistic test case scenario and an in-class testing session.

4.1 Holistic Test Case Scenario

We developed a holistic test case scenario to evaluate the functionalities of the system. The case scenario involved a 10-year-old female player in the 5th grade and her parent. First, we explained the game objective to the participants and provided some basic guidelines. Table 1 lists the test case scenario tasks for the participants. Participants were interviewed afterwards and asked to comment on the system. Observation notes and participant comments were recorded to be analyzed later.

Table 1. Test case scenario tasks for participants

#	Player's Tasks
1.	Press Start
2.	Press Play
3.	Play first level and pass to go the second level
4.	Press Spelling Rule
5.	Go back to play
6.	Play second and third levels
7.	Press Statistics
8.	Press Mistakes
9.	Reset Mistake Counter
10.	Quit
#	Parent's Tasks
1.	Add a new spelling rule along with five words
2.	Add new words to an existing spelling rule
3.	Quit

4.2 In-Class Testing Session

The system was also evaluated in a classroom setting. A class of six male 3rd grade students in a local elementary school was asked to use the system during a reading class under the supervision of their teacher. The teacher explained the spelling rule and showed the students a few examples on the board. After explaining how the game operates, the students were provided with mobile devices and began playing, while the teacher walked around observing, taking notes, and aiding when needed. Figure 8 shows some of the test subjects playing the game. The students showed high levels of motivation and interacted with the game and with each other. On several occasions, they were observed asking for teacher and/or peer assistance. A group interview was conducted after the session and the participants were asked to comment on the games. Observation notes on class dynamics and participant comments were recorded to be analyzed later.

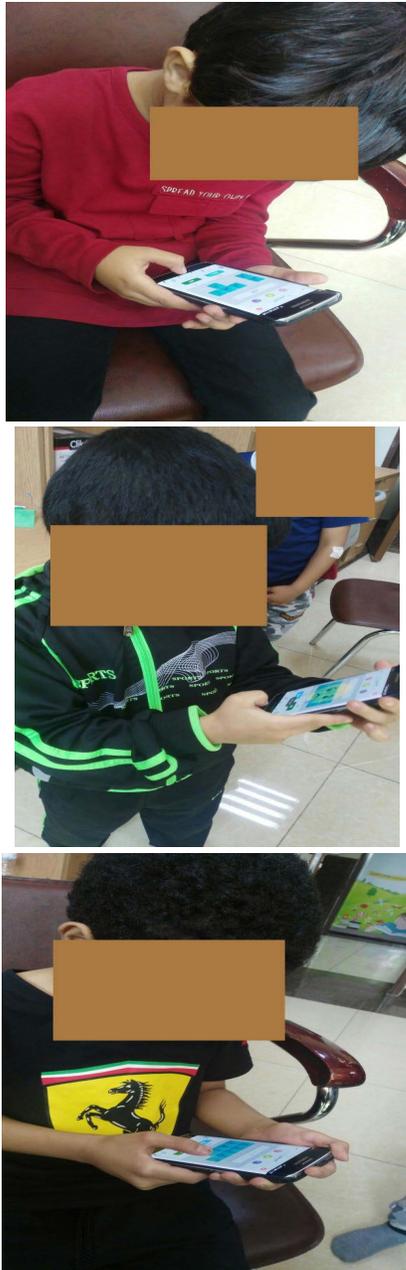


Figure 8. Students using the system in class

5. Analysis and Discussion

Data gathered from the holistic test case scenario, the in-class session, and interviews were analyzed qualitatively. Three themes emerged from the data: positive attitudes, concerns, and suggestions for improvement. Data revealed an overall positive attitude towards using the system. Participants were highly motivated and engaged, and they commented positively on the system's ease of use and their enjoyment. All students were able to per-

form the tasks successfully with minimal supervision and expressed interest in continuing to use the game. In addition, both the parent and the teacher highly appreciated the add/delete feature and especially valued the ability to record their own voices and personalize the game according to the individual needs of the learner. However, analysis also revealed some concerns associated with the system. Both the teacher and the parent commented on the system incompatibility with different mobile platforms. Another challenge stems from the distraction caused by introducing mobiles into the classroom, which does make it harder to control students.

The teacher and parent also provided suggestions for improvement, including the following items:

- Extend the game to include spelling of sentences and paragraphs,
- Increase player interaction by allowing players to play online and compete, and
- Allow users to share newly added rules or words.

The evaluation process was an integral part of this research allowing the researchers to identify the system's strengths and limitations. These limitations will be addressed in future work as presented next.

6. Conclusions

In this study, we described the development and evaluation of a personalized mobile language learning system to teach and improve spelling. The design process comprised two stages: First, analysis sessions were conducted with a focus group of five language teachers to collect data to inform the initial system requirements. Next, a user-centered design cycle was adopted to design the system. The Afaneen System consists of two components: a practical component allowing a learner to access and practices a specific spelling rule and performs other non-gaming functions, and a game component where a learner can play a spelling game and record their progress. The system can be personalized by allowing the instructor, or the parent, to add new spelling rules or new words, which are embedded automatically into both the practical and game components. The system was evaluated to test its functionality and usability. Two evaluation approaches were used: a holistic test case scenario and an in-class testing session. Data gathered through observations and interviews indicated an overall positive attitude towards using the system

and high levels of motivation and engagement. Data analysis also revealed some concerns related device/platform compatibility and player distraction issues. This research has several implications. First, involving the teachers in the design and the evaluation process, and using teacher feedback to improve the system seemed to enhance its usability. Thus, there is a great value in a two-way communication channel between developers and teachers/parents, as this dialogue has the capacity to substantially enhance the pedagogical efficiency of educational mobile applications and games. As noted by the author earlier¹⁸: “A teacher will have a specific learning scenario or task in mind and wants to use a suitable educational mobile app to support it. The teacher is often responsible to choose adequate learning apps for his learners. In early childhood also, parents might be in the teacher’s role, at least for the selection process”. Another implication involves the notion of Gamification i.e. “the use of typical game mechanics in non-game environments”¹⁸. Many believe that Gamification will have a significant impact on the teaching/learning environment and in enhancing student motivation and engagement¹⁸⁻¹⁹. Regarding future work, the system is currently available on Android via Google Play, and our intention is to develop a hybrid version that will run on all platforms in order to make it more accessible to a wide range of users. New features and tasks will be added to enhance the effectiveness of the system, such as extending the spelling challenge to sentences or paragraphs, allowing users to correct misspelled words in a passage, and integrating a dictionary of words. Further research is still needed on how to integrate the system in classroom activities with less disruption and to assess its impact on student writing.

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