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The impact of game reward mechanisms on enhancing elementary school students' English vocabulary acquisition based on the ARCS motivation model

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Abstract

As globalization progresses, the need for proficiency in a common language grows, placing emphasis on effective language learning. Vocabulary retention, as a core aspect for students' language learning, remains challenging for non-native learners. To achieve this, many educational institutions incorporate digital technologies that support long-term memory retention. Game-based learning, especially when integrated with reward mechanisms, has been shown to enhance students' motivation by providing goal-oriented incentives. This study developed the "Max Vocab Fun" app, an English vocabulary learning tool for third-grade elementary students, incorporating game-based rewards. A one group, pre-test and post-test quasi-experimental design examined the app's impact on students' vocabulary acquisition and motivation. The ARCS Model Learning Motivation Scale used to measure the motivational impact of the app's reward mechanisms. Findings show significant improvement in vocabulary retention, with the gamified approach notably benefiting lower-achieving students. Overall, the app effectively increased motivation and contributed to a more positive learning environment, demonstrating the potential of integrating game-based rewards into language learning to improve outcomes for diverse student groups.

Keywords:
ARCS model
Game-based learning
Language learning
Learning motivation
Reward mechanism.

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1. Introduction

With the widespread adoption of smart devices, the global educational technology market is experiencing rapid growth, with its market size expected to reach USD 421 billion by 2032 (Tyni et al., 2022). As an

innovative teaching method, educational technology offers new content and presentation formats, significantly driving the transformation of educational dissemination methods (Timchenko, Trapitsin, & Apevalova, 2020). Digital technology has expanded learning opportunities by overcoming the barriers of time and location that once restricted access to knowledge (Holbert & Wilensky, 2019). It has changed classrooms, enabling teachers to try new teaching approaches that ignite curiosity and encourage students to explore their studies more deeply. Studies show that digital tools make learning vocabulary more than just memorizing, but also help student to understand and remember words with fun, through repeated practices (Cavus, 2016; Klimova, 2018).

In Taiwan, English is considered a second language (ESL), the desire to learn it keeps growing. To get most out of learning a language, it's crucial to concentrate on things that help develop useful skills (DaCosta, Seok, & Kinsell, 2019). A strong vocabulary and the ability to speak confidently are essential to achieving true English fluency. Without these skills, students will find it hard to become fluent (Cinar & Arı, 2019). Vocabulary is the foundation of foreign language learning, yet for many, retaining new words for long-term is a real challenge (Elekaei, Tabrizi, & Chalak, 2020; Elmahdi & Hezam, 2020).

Huang, Su, and Chen (2015) have proven that game-based learning is a highly effective tool in enhancing learner's concentration and sense of achievement. It helps achieve instructional goals, improves learning effectiveness through experimental activities, reduces learning anxiety, and fosters active participation and innovative problem-solving skills among students (Yang, Quadir, & Chen, 2016). Additionally, gamified reward mechanisms are widely popular in academic and practical research. Common reward forms include virtual currency, money, points, medals, and physical rewards (Lewis, Swartz, & Lyons, 2016). Different rewards have varying effects on learning motivation; adolescents, in particular, are more sensitive to rewards (Martin, Silander, & Rutter, 2019). Among these, monetary rewards are considered the most motivating, as they provide strong incentives in games and promote goal achievement in real life (Garbers & Konradt, 2014). Thus, strategies that enhance learning motivation and interest through gaming are widely regarded as effective (Chao, Yang, Hsien, & Chang, 2018; Hon & Liu, 1997).

In education, learning motivation is one of the core elements in instructional strategy design and is often associated with classroom management, reinforcement of learning, and emotional outcomes (Keller, 1987b). Keller (1987a) based on the "expectancy-value theory," proposed the ARCS Motivation Model, which aims to stimulate students' learning interest by designing instructional strategies that relate learning content to the actual needs of students. This enhances their confidence in learning and ensures that the learning experience brings satisfaction. The ARCS model comprises four key dimensions: Attention, Relevance, Confidence, and Satisfaction (Keller & Knopp, 1987). This model has been validated and applied in various research environments (Keller, 1987a) and has developed into a systematic process that includes definition, design, development, and evaluation (Keller, 1987b).

This study adopts the ARCS model as the theoretical framework, using a learning motivation scale to explore the impact of gamified reward mechanisms on students' learning motivation.

1.1. Research Purpose

This study explores the impact of vocabulary learning application, "Max Vocab Fun," based on game-based reward mechanism integrated with the ARCS model. The application is designed to improve elementary school students' motivation and effect their English vocabulary learning, as it will enhance their attention and interests.

The research questions are as follows:

RQ1: How does the Max Vocab Fun app, developed based on a game reward mechanism, impact third-grade elementary school students' English vocabulary learning effectiveness?

RQ2: How does the Max Vocab Fun app, developed based on a game reward mechanism, affect students with varying levels of English achievement?

RQ3: How does the Max Vocab Fun app, developed based on a game reward mechanism, influence the ARCS learning motivation of students with different levels of English achievement?

1.2. Research Limitations

Language learning is broad, and vocabulary acquisition is crucial in reading comprehension and oral communication. Vocabulary growth significantly impacts students' reading comprehension and academic performance (Nation & Nation, 2001; Schmitt, 2008). Therefore, this study focuses on elementary school students in Taiwan, emphasizing the effectiveness of English vocabulary learning. The study is limited to vocabulary acquisition and does not represent the overall outcomes of language learning.

2. Literature Review

2.1. Trends in Educational Technology

In recent years, the application and development of educational technology have rapidly evolved, becoming a significant driving force behind global educational innovation. According to the systematic review by Zawacki-Richter, Marín, Bond, and Gouverneur (2019) technologies such as digital learning tools, artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) are increasingly being integrated into educational systems, enhancing teaching effectiveness and learners' experiences. These tools support

improvement in student learning engagement by creating immersive learning experiences (Clark & Mayer, 2016). According to Bond, Marín, Dolch, Bedenlier, and Zawacki-Richter (2018) the interactivity in technologies are useful particularly for encouraging students engagement and participation fully in exploring and learning.

The theory of multimedia learning, as noted by Mayer (2014) emphasize the combination of visuals and text in digital contexts to foster comprehension and memory retention. Through this multisensory approach, students can grasp the concepts easily, while making their learning memorable. In addition, this approach aligns well with self-directed learning, whereas students can control their learning pace and strength of their engagement, which play a vital role in contributing to the development of skills like critical thinking and innovative problem-solving (Smith & Okolo, 2010).

Studies, such as the one by Roschelle, Pea, Hoadley, Gordin, and Means (2000) have shown that digital tools encourage collaboration in learning, so that students are allowed to engage in complex problem-solving tasks, and receive real-time feedback as well as group discussions. Chang, Kao, and Wang (2022) also found that virtual reality is an important tool that improves students' creativity and spatial awareness in design education, while demonstrating the value of immersive technology in areas where visualization and perception are important. Such advancements are not only support personalize learning experience, but also improve access to resources, and create opportunities to education more equitable across diverse students' backgrounds.

2.2. Application of Game-Based Learning in Education

Game-based instructional methods have been increasing its popularity in academic settings due to their impact on fostering students' curiosity, motivation, and essential cognitive skills. By integrating play and learning, students engage with educational material in a way that improves their reasoning, abstract thinking, and adaptability (Chuang, Jhih, & Wang, 2024). These approaches have also shown promise in reducing learning costs and standardizing instructions, which led to a greater consistency in content delivery across students' diversity. The consistency, coupled with real-time development in game-based applications, enables dynamic learning environment that responds to individual students' needs. As a result that many countries are investing in these developments (Spires & Lester, 2016).

The integration of game elements, such as challenges, rewards, and feedback loops, is crucial for uplifting students engagement and learning tasks sustainability (Chao et al., 2018). Studies affirm that these methods are particularly effective for acquiring knowledge and skills, providing students with real-time feedback, which let them learn from their mistakes, retry tasks, and confidence building through successive accomplishments (Plass, Homer, & Kinzer, 2015; Wouters, Van Nimwegen, Van Oostendorp, & Van Der Spek, 2013). The aspects of collaboration in game-based learning, contributes significantly to performance, particularly in areas like science and mathematics, where the active exploration of problem-solving concepts is beneficial (Clark & Mayer, 2016; Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012). This method encourages students in support each other's progress, reinforcing social interactions and cognitive skills, that are important in group and game-based learning (De Freitas, 2018; Tsekleves, Cosmas, & Aggoun, 2016).

2.3. The Learning Benefits of Reward Mechanisms and the ARCS Model

In Educational setting, reward system play a crucial role in encouraging participation and perseverance. The ARCS model, developed by Keller (1987a) emphasizes the importance of capturing and retaining interests of the students using four main components; Attention, Relevance, Confidence, and Satisfaction. When these components are careful integrated, they help build a sense of connection to the content, support engagement and boost motivation to students. Rewards, such as points, badges, or leaderboards, are part of reinforcement that promote learning persistence and gradual internalization of new knowledge. Such systems can be particularly impactful in maintaining student focus and increase confidence levels, due to its capacity of encouraging students to achieve learning milestones (Mekler, Brühlmann, Tuch, & Opwis, 2017; Sung & Hwang, 2013).

Mora, Riera, González, and Arnedo-Moreno (2017) further analysed how the reward can improve relevance and satisfaction, showing that when incentives align with students' goals, they can greatly amplify a sustained motivation. Moreover, the immediate positive feedback has been linked to motivate satisfaction upon completing tasks, fostering positive attitude toward continued learning. In fact Sailer, Hense, Mayr, and Mandl (2017) suggest that these systems can be adapted to nurture both extrinsic and intrinsic motivation, creating a comprehensive support for long-term educational benefits. Chuang et al. (2024) emphasize that a well-designed reward mechanism foster creativity, as they provide the necessary encouragement that enables creative risks and experiment during learning process.

As reward system offer numerous benefits, their design must strike a balance between extrinsic rewards and fostering intrinsic interest. When rewards are carefully designed to Alling with students' autonomy and personal interests, they can lead to a stronger intrinsic motivation, making learning enjoyable and meaningful. Educational technology developments, enable these reward systems to be tailored to individual preferences and learning styles, promoting an enrichment learning experience for diverse learners. As the field of educational technology grows, these models are likely to support further customization to ensure both engagement and learning outcomes are maximised.

3. Method

3.1. Research Design

Vocabulary is the foundation of English learning and is especially important for non-native learners. According to Taiwan's 2019 Curriculum Guidelines, elementary school graduates must master at least 300 English vocabulary words (Ministry of Education, 2018). However, to enhance the flexibility and adaptability of teaching materials, textbooks can include vocabulary beyond the curriculum guidelines based on actual needs. Third-grade elementary school students were selected in this study, and textbooks from Kang Hsuan, Nani, and Hanlin publishers (Zhuang, 2006) were used as the core learning materials. The vocabulary from these textbooks was categorized and appropriately expanded, forming the main content for student learning and pre-test and post-test.

During the app's development, we invited teachers and students to participate in testing to ensure the accuracy of the learning content and the stability of the system's functionality. The primary purpose of this testing was to confirm that the app was free from programming errors and that the learning content aligned with the educational goals. After the experiment, we collected feedback from teachers and students, along with test data and scores, for detailed analysis and discussion to evaluate the app's effectiveness in improving students' learning effectiveness and the appropriateness of the learning materials.

This study employed a one-group pre-test and post-test quasi-experimental design to investigate the impact of the "Max Vocab Fun" app on elementary school students' learning achievements and motivation. To analyse learning effectiveness, a paired-sample t-test was used to compare the differences in students' scores between the pre-test and post-test, to assess the actual impact of the app on vocabulary learning. Additionally, to assess changes in learning motivation, descriptive statistics and paired-sample t-tests were used to analyse students' motivation across the ARCS model dimensions (Attention, Relevance, Confidence, and Satisfaction). This analysis further evaluated the specific effects of the "Max Vocab Fun" app in enhancing students' learning motivation.

3.2. Participants

Based on the "Digital Learning Advancement Plan for Primary and Secondary Schools" implemented by the Ministry of Education in Taiwan from 2022 to 2025, all elementary and secondary school classes from grades one to twelve are equipped with internet access and tablets for every student. This study utilized the resources provided by this plan, installing and testing the learning software on the tablets available at the experimental school. The participants in the study were third-grade students from a public elementary school in central Taiwan, comprising a total of 70 students from 3 classes, including 39 boys and 31 girls. Additionally, three teachers participated in the study. The participants' demographics and classifications are shown in Table 1.

Table 1. Gender and achievement level distribution.

Achievement level	Male (N = 39)	Female (N = 31)	Total (N = 70)
High	18	14	32
Medium	17	13	30
Low	4	4	8

3.3. Research Tools

This study employed several tools to assess students' learning effectiveness and motivation effectively. The main tools are as follows:

3.3.1. ARCS Learning Motivation Scale

To assess students' motivation after using the "Max Vocab Fun" app, the study adopted Keller (1987b) ARCS Learning Motivation Scale. This scale includes four dimensions: Attention, Relevance, Confidence, and Satisfaction. The scale consists of 12 questions, with each dimension containing 3 questions, and uses a five-point Likert scale for evaluation (1 representing "strongly disagree" and 5 representing "strongly agree"). The Cronbach's Alpha reliability coefficient for the scale is 0.85, indicating good reliability and effectiveness in measuring students' learning motivation.

3.3.2. Pre-Test and Post-Tests

Pre- and post-tests were designed to measure students' progress in vocabulary learning. The test content was primarily selected from the third-grade English textbooks of Kang Hsuan, Hanlin, and Nani publishers (Zhuang, 2006) and expanded and categorized based on the 2019 Curriculum Guidelines. Experienced elementary school English teachers reviewed the test questions to ensure appropriateness and validity. The tests included vocabulary questions of varying difficulty to assess students' vocabulary acquisition comprehensively.

3.3.3. Learning Progress Tracking System

The 'Max Vocab Fun' app, developed for this study, features an integrated learning progress tracking system. This system is designed to adapt to students' learning activities, automatically tracking their time

spent on each session, accuracy of responses, records of incorrectly answered vocabulary, reward redemption, and points accumulation. This adaptability allows teachers and researchers to monitor students' learning progress in real time and analyse the data to evaluate the app's impact on students' learning effectiveness.

3.4. Experimental Procedure

This study utilized a quasi-experimental design to explore the impact of the game-based learning app "Max Vocab Fun" on the English vocabulary learning effectiveness and motivation of third-grade elementary school students. The experimental procedure is as follows (as illustrated in Figure 1):

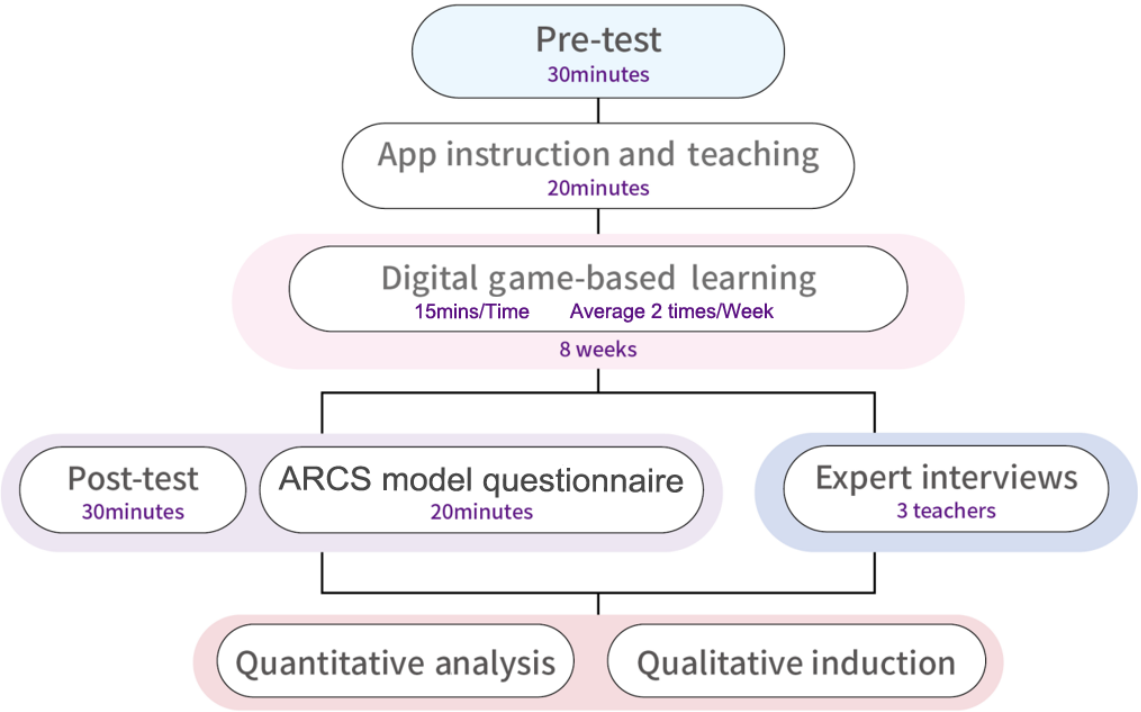

Figure 1. Experimental design flowchart.

3.4.1. Pre-Test Stage

Before the experiment begins, participants take a 30-minute pre-test to assess their initial mastery of the target vocabulary. The pre-test includes vocabulary selected from the third-grade English textbooks of Kang Hsuan, Hanlin, and Nani publishers. The pre-test results serve as the baseline for subsequent analysis of learning effectiveness.

3.4.2. App Usage Instruction

Following the pre-test, students attended a brief orientation session on how to use the "Max Vocab Fun" app effectively. This 20-minutes session provided an essential guidance on navigating the app and understanding its core functionalities, such as selecting learning modules, engaging with vocabulary exercises, and using the reward system. Students received specific instructions on how they could earn points and redeem rewards through consistent usage, emphasizing the app's role in supporting their vocabulary acquisition. This preparatory instruction ensured that students were equipped to maximize their learning experience within the app environment.

3.4.3. Learning Stage

Throughout the experimental period, students engaged with the app twice per week, dedicating 15 to 20 minutes per session over a course of eight weeks. During each session, the variety of vocabulary exercises were accessible to students, tailored to their learning level, as presented within the app's structured learning units and interactive challenge modes. These activities were designed to reinforce vocabulary memorization and provide immediate feedback. The app tracked several metrics, including time spent on activities, accuracy rates, and collective points, to allow a detailed record of each student's learning engagement and progression.

3.4.4. Post-Test Stage

At the completion of the learning phase, students completed a post-test designed to mirror the initial pre-test, allowing the assessment of vocabulary acquisition over the study period. By comparing pre and post-test results, the research supposed to quantitatively measure any improvements in vocabulary memorization and understand attributable to app usage, as to provide a basis evaluation of the app's educational impact.

3.4.5. Questionnaire and Interviews

After the post-test, students were required to complete a questionnaire based on the ARCS model, which evaluated shifts in motivation linked to their experiences in using the app. Then, interviews were conducted to teachers who monitored students' engagement during the study period. These discussions offered valuable insights into students' behavior, motivation, and response to the app's features, improving the quantitative data with provided qualitative perspectives on the app's efficacy and areas for improvement.

3.4.6. Data Analysis

To assess the app's overall impact, statistical analysis was conducted on data collected from the pre and post-test, motivation questionnaire, and usage metrics recorded by the app. The analysis included paired-sample t-tests to identify significant differences between pre and post-test scores, measuring the app's effectiveness in vocabulary learning. Correlation analysis was applied as well, to examine any relationships between students' motivation levels and achievement outcomes, while offering a comprehensive view of the app's influence on both cognitive and motivational aspect of learning.

3.5. APP Planning Structure

The "Max Vocab Fun" app is designed to integrate game-based learning theory with the ARCS learning motivation model, aiming to improve elementary school students' English vocabulary learning through game-based reward mechanisms. The app includes multiple functional modules to cater to different learning needs and enhance the student's learning experience. The structure is as follows (as illustrated in Figure 2):

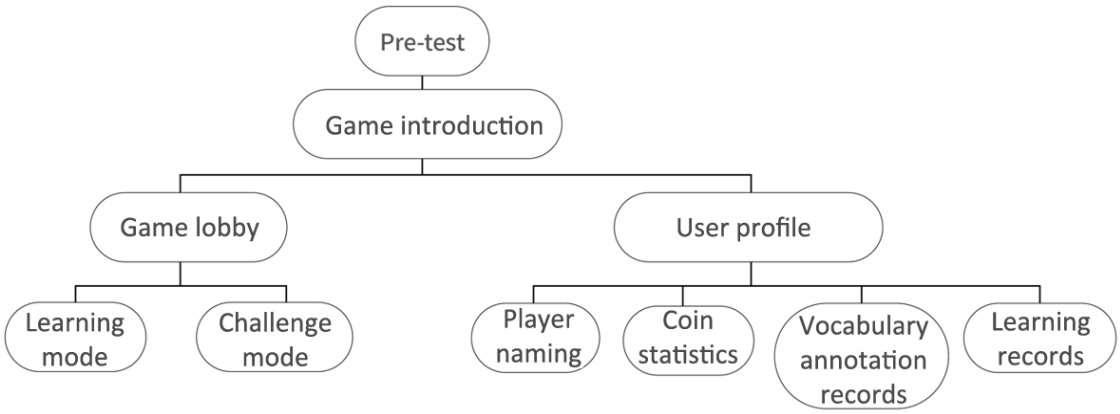

Figure 2. Max vocab fun app architecture diagram.

3.5.1. Learning Unit Mode

In the Learning Unit Mode, students can select vocabulary from various themes for study. Each unit includes vocabulary, images, audio, and annotation features to help students reinforce their memory through multi-sensory stimulation. The vocabulary content is categorized and expanded based on third-grade English textbooks from Kang Hsuan, Hanlin, and Nani publishers (Zhuang, 2006). This mode emphasizes self-directed learning, allowing students to choose units based on their needs and adjust their learning pace freely.

3.5.2. Challenge Mode

Challenge Mode offers time-limited vocabulary quizzes with randomly mixed questions to help students reinforce learned words during the challenge. Each challenge is uniquely generated with different questions and answers options, promoting memorization and critical thinking. Students receive immediate feedback on their answers, helping them identify and correct their mistakes. For each incorrect answer, a "heart" is deducted, work as a motivating factor for students to strive for accuracy, while full completion of the challenge restores any lost hearts. This mode aims to build stronger vocabulary memory and improves students' ability to manage tasks effectively and timely.

3.5.3. Reward Mechanism and Points System

The app incorporates a motivational reward structure that encourages students to participate consistently by awarding points based on their performance in vocabulary activities. Different from the introduction in the App Usage Instruction, which primarily covered operational aspects, this system is specifically designed to maintain engagement throughout the learning journey. Students can accumulate these points to unlock a variety of virtual rewards, which introduce a fun, game-like element that aligns with learning goals. Also, students earn coins that can be redeemed for physical rewards, providing a tangible incentive to encourage their learning motivation experience. The immediate feedback from this system reinforces positive behaviors, let students involve actively as they towards vocabulary mastery.

3.5.4. Learning Progress Tracking

The app's tracking feature, provides continuous monitoring of students' activities, focusing on real-time metrics such as time spent on tasks, completion rates for challenges, and accuracy levels. This tracking mechanism is distinct from the one-time assessments in the post-test stage. This records ongoing engagement and progress, giving students instant feedback on their learning journey. After accumulating data across multiple sessions, the system builds a comprehensive profile of each student's strength and weak areas that need improvement. Also, this feature enables teachers and parents to observe patterns in the students' learning behavior over time and supports targeted guidance to personalized adjustments to maximize vocabulary retention and skill acquisition. This dynamic tracking, provides an in-depth view of each student's learning trajectory, complementing the broader analysis conducted during final data analysis.

3.5.5. Virtual Character and Interaction Features

To improve engagement for users, the app introduces an interactive virtual character that mirrors the age group of the students, creating a relevant learning assistant. This character offers an encouraging message throughout the learning process, while provides a sense of companionship and support. In addition, students can mark challenging words for future study, using an annotation feature that allows them to revisit and practice difficult vocabulary items. These interactive features foster a sense of accomplishment and connection, further motivating students to engage consistently with the app.

The game lobby includes two learning modes: "Learning Unit" and "Ability Challenge." In the Learning Unit mode, players can freely choose different units to study, which include vocabulary, images, audio, and annotation features. These various sensory stimuli assist in vocabulary retention. See Figure 3.

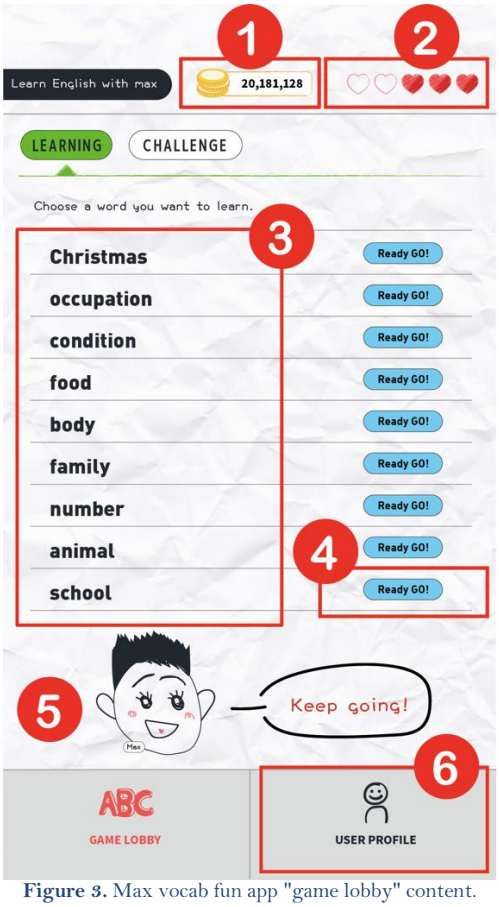

Figure 3. Max vocab fun app "game lobby" content.

(1) Points: Accumulation of points through learning activities and challenges.

(2) Number of Challenges and Heart Deduction: One heart is deducted for each incorrect answer in learning and challenge modes. Once all five hearts are used up, students must wait for them to regenerate. The heart regeneration mechanism restores one heart every two minutes. Additionally, if students correctly answer all ten challenge questions, they can earn back one heart as a reward.

(3) Learning Content: This is primarily based on the third-grade curriculum, using textbooks from Kang Hsuan, Hanlin, and Nani publishers (Zhuang, 2006). After categorizing the vocabulary, additional words are slightly expanded to increase the overall word count.

(4) Start Learning: Select a type and begin learning.

(5) Virtual Character: A virtual character, designed to be similar in age to the learners, is included to cheer them on and offer encouragement during the learning process.

(6) Learning Progress: The app records and displays daily learning time, total learning time, rewards redeemed, number of mistakes made, and marked words for review, providing a comprehensive overview of the learning journey.

All vocabulary words are randomly mixed and presented in a time-limited quiz in the Ability Challenge mode. The number of attempts a player can make is determined by the number of hearts available, with one heart being deducted for each incorrect answer. Players earn points through learning and challenges, reflecting their learning effectiveness and progress. See Figure 4. and Figure 5 illustrates students' use of the Max vocab fun app and their learning record information.

Figure 4. Max vocab fun app "learning progress" content.

(7) Username: Learners can set their nickname in either Chinese or English. Chinese nicknames can have up to 10 characters, and English nicknames can have up to 20 letters.

(8) Current Points: Accumulated points or in-game currency earned from gameplay.

(9) Reward Redemption: The redemption system allows students to exchange points for physical rewards. Before use, the system must be configured to deduct points in whole numbers (e.g., 1K = 1000 coins). For example, if students have 5400 coins, they can redeem up to 5K (5000 coins), leaving 400 coins. Coins less than 1000 are carried forward for future redemption.

(10) Learning Progress:

(a)Today's Learning Hours: Provide students or teachers with the total hours accumulated today.

(b)Today's Mistakes: Shows the number of mistakes made that day to help students or teachers track learning performance.

(c)Total Learning Time: Displays the student's total learning hours during the experimental period to track usage frequency.

(11) Vocabulary Annotation: Words marked by clicking the "annotation button" in both the "Learning Unit" and "Ability Challenge" modes will be stored here for students to review and study repeatedly.

(a) Annotation Button: This button is available in both the "Learning Unit" and "Ability Challenge" modes. It allows students to mark words for future review and repeated learning.

(b) Audio Learning: This button is also available in both the "Learning Unit" and "Ability Challenge" modes. It allows students to listen to word pronunciations, which can be replayed for repeated practice.

(12) Game Lobby: Returns to the main menu with options to navigate to the "Learning Unit" and "Ability Challenge" pages.

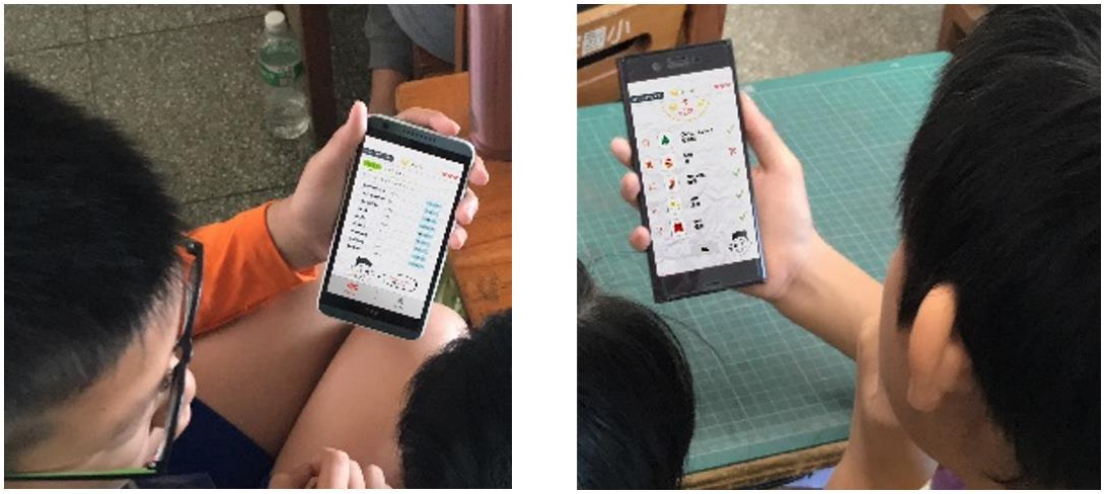

Figure 5. Student learning records.

4. Experimental Results

This study analyzed students' learning effectiveness after using the "Max Vocab Fun" app for English vocabulary learning through pre-test and post-test score data. A paired-sample t-test was conducted to examine the differences between pre-and post-test scores, and a group analysis was performed based on students' learning achievements. The results are as follows:

4.1. Overall Learning Effectiveness

The study sample consisted of 70 third-grade elementary school students. Statistical analysis revealed that the average post-test scores were significantly higher than the pre-test scores. The average pre-test score was 79.97, while the average post-test score was 88.01, showing a difference of 8.04 points (see Table 2). A paired-sample t-test was conducted, and the results indicated a t-value of -7.558 with a significance level of ($p < 0.001$), demonstrating that the improvement in students' vocabulary learning effectiveness was statistically significant (see Table 3). This suggests that students' mastery of English vocabulary improved significantly after using the app for learning.

Table 2. Average scores of pre-tests and post-test.

Variables	N	M	SD
Pre-test	70	79.97	17.242
Post-test	70	88.01	13.175

Table 3. Analysis of pre-test and post-test learning effectiveness.

Variables	M	SD	S. err	t	Sign.
Pre-test Post-test	-8.043	8.903	1.064	-7.558***	0.000

Note: *** $p < 0.001$.

4.2. Analysis of Learning Effectiveness for Students with Different Achievement Levels

This study further analysed the score changes among students with different levels of achievement. Students were grouped into high, medium, and low achievement categories based on their pre-test scores, and their performance was compared. The results indicated that all three groups improved their post-test scores compared to the pre-test. Notably, the low-achievement group showed the most significant progress, with scores increasing from 50.00 in the pre-test to 62.50 in the post-test, a 12.5-point gain. The medium-achievement group improved from 73.50 to 86.00, also a 12.5-point increase. Meanwhile, the high-achievement group showed a smaller improvement, with scores rising from 93.53 to 96.28, an increase of only 2.75 points (see Table 4). These findings suggest that the "Max Vocab Fun" app had a particularly strong effect in enhancing the learning effectiveness of low-achievement students.

Table 4. Learning effectiveness by achievement level.

Group	N	Pre-test (M)	Post-test (M)	Score increase
High achievement	32	93.53	96.28	+2.75
Medium achievement	30	73.50	86.00	+12.50
Low achievement	8	50.00	62.50	+12.50

4.3. Correlation Between ARCS Learning Motivation and Learning Effectiveness

Using the ARCS Learning Motivation Scale, the study also investigated the connection between learning motivation and learning effectiveness. The results revealed a positive correlation between learning motivation and learning effectiveness. The questionnaire responses showed that most students found the app engaging for vocabulary learning, which enhanced their learning experience. Notably, low-achievement students reported significant improvements in the 'Confidence' and 'Satisfaction' dimensions. This suggests that the gamified reward system substantially impacted their motivation, leading to improved learning effectiveness. For more details, see Table 5.

Table 5. Survey on ARCS learning motivation analysis.

Dimension	High achievement (N=32)		Medium achievement (N=8)		Low achievement (N=30)	
	M	SD	M	SD	M	SD
Attention	4.92	0.072	4.65	0.156	4.56	0.162
Relevance	4.36	0.123	4.54	0.242	4.65	0.132
Confidence	4.41	0.419	4.53	0.326	4.54	0.189
Satisfaction	4.62	0.278	4.59	0.178	4.50	0.125

Based on the above analysis, a paired-sample t-test was conducted on the "Attention" data for both high- and low-achievement students. The results showed a t-value of 6.828, with a significance level of less than 0.05, indicating statistical significance. See Table 6 for details.

Table 6. Attention dimension correlation between high and low achievers.

Variables	M	SD	S. err	t	Sign.
High achievement - Low achievement	0.353	0.089	0.051	6.828*	0.021

Note: * $p < 0.05$.

In summary, the data results indicate that the "Max Vocab Fun" app effectively enhances students' English vocabulary learning effectiveness, particularly for low-achievement students, whose learning progress was more pronounced. The app's game-based learning mechanisms significantly boosted students' learning motivation and created a positive learning environment, improving learning effectiveness.

5. Discussion

The rapid development of digital technology has greatly diversified educational technology, creating favorable conditions for students to develop autonomous learning abilities. Teachers can use Internet technology to build learning resource platforms and plan multimedia learning resources. It enables students to explore learning resources autonomously and helps them construct new knowledge.

Q1. The Impact of the Max Vocab Fun App on the English Vocabulary Learning Effectiveness of Third-Grade Elementary School Students.

Findings from the study shows the "Max Vocab Fun" app is effective in enhancing students' vocabulary learning for third-grade students. The app's integration of gamified rewards elements, such as points and virtual coins, provided continuous motivation, contributing to a noticeable improvement in vocabulary retention. Through interactive elements and immediate incentives, students demonstrated increased focus and motivation, which helped to sustain their learning efforts and interests. The opportunity to earn rewards fostered an environment where students felt encouraged to practice tasks consistently, leading to higher post-test scores compared to the pre-test results. This confirms that using game-like incentives in language learning can build vocabulary acquisition, supporting the educational value of integrating structured reward mechanisms.

Q2. The Impact of the Max Vocab Fun App on Students with Different Levels of Learning Achievement.

The app's stimulus varied based on students' initial achievement levels, with both high and low-achieving students showing positive responses but differing in their engagement and outcomes. While high-achieving students expressed satisfaction and confidence in meeting the app's challenges, low-achieving students reported significant increases in motivation, particularly in their enthusiasm for learning and self-confidence. However, low-achieving students provided more positive feedback than their high-achieving peers, especially regarding increased interest and confidence. This suggests that the game reward mechanisms were more appealing to low-achieving students, effectively enhancing their participation and motivation and promoting their learning progress. Compared to high-achieving students, low-achieving students benefited from the

positive reinforcement of accumulating points and redeeming rewards during the game, which played a key role in improving their persistence in learning.

Q3. The Impact of the Max Vocab Fun App on the ARCS Learning Motivation of Students with Different Levels of Learning Achievement.

According to the results from the ARCS Learning Motivation Scale, the study found that the "Max Vocab Fun" app enhanced students' learning motivation across the four dimensions of the ARCS model (Attention, Relevance, Confidence, and Satisfaction):

1. The audio and visual elements in the game successfully captured students' attention, with low-achieving students scoring particularly high in this dimension, indicating that the game-based learning environment effectively stimulated their interest and focus.
2. The app's design of the learning content, was structured relevant to students' everyday contexts, providing material more accessible and meaningful. This relevance was particularly beneficial for students struggling with motivation, as it connected learning with practical language use, thus enhancing engagement.
3. Teachers' feedback, indicated that, as students progressed through the app's challenges, then the reward system helped them to build a sense of achievement, especially for lower-achieving students. Completing tasks and receiving immediate rewards reinforced their self-assurance, encouraging a positive self-esteem related to their learning capabilities.
4. The immediate gratification offered by the app's reward mechanisms allowed students to feel a sense of accomplishment with each completed task. This immediate satisfaction proved highly motivating for all students but was especially impactful for low-achieving students, as it validated their efforts and kept them engaged in the learning process.

These results demonstrate that the app's use of gamified rewards played a crucial role in enhancing both motivation and engagement. The ARCS model provided a supportive framework, with each component reinforcing student participation and promoting an encouraging learning environment. For students with initially low achievement, these mechanisms proved essential in fostering a more positive and sustained approach to vocabulary acquisition.

6. Conclusion

Throughout this research on evaluating the impact of game reward mechanisms on enhancing elementary school students' English vocabulary acquisition based on the ARCS motivation model, the results confirmed that integrating game-based rewards within a structured learning app significantly boosts vocabulary retention and student engagement, with particularly strong effects observed in students with lower baseline achievement. All students exhibited significant improvements in vocabulary proficiency, as evidenced by significant gains in post-test scores compared to pre-test results. These improvements affirm the app's capability to enhance vocabulary acquisition effectively, regardless of students' prior performance levels. Particularly, the app had a unreasonably positive effect on lower-achieving students, demonstrating that gamified rewards can play a vital role in fostering engagement, enhancing motivation, and promoting continuous learning across different student profiles.

Additionally, the study found that the game reward mechanisms performed excellently in boosting learning motivation. The results of the ARCS Motivation Scale indicated that students scored highly in the dimensions of "Attention," "Confidence," and "Satisfaction." This shows that the app's game elements and instant feedback mechanisms successfully captured students' attention and motivated them to continually challenge themselves, aiming for higher learning achievements. Furthermore, the points and reward system effectively boosted students' learning confidence, particularly for low-achieving students, significantly improving their satisfaction with learning and encouraging them to participate in their studies actively.

Although the results showed that the gamified learning app significantly improved students' learning effectiveness and motivation, this study has some limitations. First, the experiment was conducted only with third-grade elementary school students in central Taiwan, and the sample size was limited, so the generalizability of the findings requires further validation. Second, the study focused solely on vocabulary learning effectiveness without examining the impact on other language skills (such as listening, speaking, reading, and writing). Future research could expand into broader areas of language learning.

In conclusion, this study confirmed the effectiveness of the game reward mechanism based on the ARCS motivation model in enhancing elementary students' English vocabulary learning effectiveness and motivation. Future research can further explore the impact of different reward mechanism designs on learning effectiveness in other subjects and expand the sample size to improve the generalizability and applicability of the findings. As digital technology advances, the prospects for applying gamified learning design in education will become even broader.

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