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ARTICLE / ARTÍCULO

Analysis of the Impact of Using a Gamified App for Spanish Spelling Practice in Primary Education

Análisis del impacto del uso de una aplicación gamificada para la práctica de la ortografía en español en Educación Primaria

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Abstract: This study evaluates the impact of GAUBI, a gamified app designed for Spanish spelling practice in primary education, using a quasi-experimental pretest-posttest design with 114 fourth-grade students. Participants were divided into three groups: traditional methods (control group), app use in classrooms (experimental group 1), and app use at home (experimental group 2). The app featured levels of arcade, research, and interactive fiction gameplay, scaling cognitive challenges to enhance learning. The intervention spanned three weeks, with participants engaging in structured app-based or traditional spelling exercises. Results showed that the group using the app at home achieved significantly higher spelling accuracy than those using traditional methods or app-only classroom approaches. Statistical analyses confirmed the superior effectiveness of home-based app use. The Binomial Effect Size Display highlighted notable improvements in specific spelling categories, such as complex letter combinations and accent rules. Discussion centered on the benefits of integrating gamification and ubiquitous learning tools in education, emphasizing the app's adaptability and immediate feedback, which encouraged independent learning and sustained motivation. The study advocates for blending traditional and gamified approaches to foster comprehensive spelling competence, supporting educators with analytics-driven insights. The research underscores the app's potential to address broader curricular goals, including sustainable development objectives.

Keywords: Gamification, Spelling Instruction, Mobile Learning, Primary Education, Educational Technology.

Resumen: Este estudio evalúa el impacto de GAUBI, una aplicación gamificada diseñada para la práctica de ortografía en español en Educación Primaria, utilizando un diseño cuasi-experimental con pretest y posttest, y una muestra de 114 estudiantes de cuarto curso. Los participantes se dividieron en tres grupos: métodos tradicionales (grupo de control), uso de la aplicación en el aula (grupo experimental 1) y uso de la aplicación en el hogar (grupo experimental 2). La aplicación incluía niveles de juego tipo arcade, investigación y ficción interactiva, escalando desafíos cognitivos para potenciar el aprendizaje. La intervención duró tres semanas, con los participantes realizando ejercicios estructurados basados en la aplicación o métodos tradicionales de ortografía. Los resultados mostraron que el grupo que utilizó la aplicación en casa alcanzó una precisión ortográfica significativamente mayor que aquellos que usaron métodos tradicionales o la aplicación exclusivamente en el aula. Los análisis estadísticos confirmaron la efectividad superior del uso de la aplicación en el hogar. El tamaño del efecto mostró mejoras notables en categorías específicas de ortografía, como combinaciones complejas de letras y reglas de acentuación. La discusión se centra en los beneficios de integrar herramientas de gamificación y aprendizaje ubicuo en la educación, destacando la adaptabilidad de la aplicación y su retroalimentación inmediata, que fomentaron el aprendizaje autónomo y una motivación sostenida. El estudio aboga por combinar enfoques tradicionales y gamificados para fomentar una competencia ortográfica integral, apoyando a los educadores con análisis basados en datos. La investigación resalta el potencial de la aplicación para abordar objetivos curriculares más amplios, incluidos los relacionados con el desarrollo sostenible.

Palabras clave: Gamificación, Enseñanza de la ortografía, Aprendizaje móvil, Educación Primaria, Tecnología Educativa.

1. Introduction

Orthography is a fundamental component of the Spanish learning process, and mobile technology has been providing resources for orthographic learning for several years. However, a digital orthographic learning system that substantially improves students' orthographic skills has yet to be established. Digital orthographic learning is shaped by pedagogical and didactic proposals developed by many educators. These proposals are based on the educational use of social networks, microblogging applications, and the appropriate use of the spell-check tool in word processors, among other methods. Additionally, numerous websites and applications available on both the Android and Apple stores enable audiovisual work on orthographic content through gamified proposals. In this article, we will analyze the didactic functionality of the GAUBI App (<https://www.gaubifun/>), which is the result of the R&D project titled: «Gamification and Ubiquitous Learning in Primary Education. Development of a Competency and Resource Map for Teachers, Students, and Parents (GAUBI)» (RTI2018-099764-B-100). Its design and development have been approached from a theoretical-practical perspective, with a foundation in gamification, to offer an interactive, accessible, sustainable, safe, attractive application with a clear curricular connection for teaching Spanish orthography in Primary Education.

1.1. *The Teaching of Orthography: From Paper Methods to Technology*

According to the Common European Framework of Reference for Languages (CEFR), «orthographic competence entails the knowledge and skill in the perception and production of the symbols that comprise written texts» (Council of Europe, 2002, p. 114). Therefore, orthography is an essential aspect of linguistic and communicative competence in Spanish, as correct writing enhances written communication and reading comprehension. The significance of this is reflected in the foundational knowledge (content) of the Royal Decree of Minimum Teaching Requirements for Primary Education, which stipulates the following content under «3. Processes»: the production of written text through orthography based on textualization and automatic correction, individual or group work strategies that promote planning, revision, and self-correction of activities, in addition to correct writing accompanied by digital tools (Royal Decree 157/2022, p. 80).

Similarly, the orthographic component is integral to the objectives of basic education in both Primary and Secondary Education, impacting all areas and subjects of the curriculum from a cross-curricular perspective (LOMLOE, 2020). Article 19 of the LOMLOE (2020) delineates the pedagogical principles for the Primary Education stage, emphasizing the cross-curricular approach to reading comprehension and oral and written expression in all areas. In this regard, the acquisition of orthography in Primary Education is a crucial aspect, as it is during this stage that students lay the essential foundations for their development and application in written texts, making it an essential learning element connected to all areas.

Furthermore, it is important to highlight that the orthographic component, since the massive advent of technology, has adopted various methodological approaches. However, new challenges such as textisms and abbreviations have also emerged, complicating the consolidation of correct orthography when writing on screens in almost all languages (Finkelstein & Netz, 2023; Gómez-Camacho et al., 2023). According to the Royal Spanish Academy (RAE, 2010), orthography establishes the

graphemes and rules for accentuation, punctuation, sounds, abbreviations, and the use of uppercase and lowercase letters in writing. This facilitates adequate linguistic and communicative competence in the production of written texts and aids in improving interpersonal and socio-professional relationships by demonstrating proper language use. The learning of orthography involves two fundamental spheres: the first is content-based, where the student must know the fundamental rules governing the orthographic system—in this case, Spanish. However, the most crucial aspect is the didactic and methodological approach used both inside and outside the classroom to develop orthographic knowledge and, most importantly, to ensure students' correct application in writing. Orthographic learning also contributes to the development of memory, attention, reasoning, auditory capacity, and visual skills (Rodríguez & Sánchez, 2018).

In this context, achieving adequate orthographic competence depends on various variables, including pedagogical methods, reading, continuous practice, feedback, and the student's critical analysis when composing their writings, as well as the socio-cultural and economic level of their families, among many other variables (Villacres Arias et al., 2020). It is important to note that methods for learning orthography differ among languages, as they do not share the same phonological system. In the case of Spanish, there are 24 phonemes—5 vowel sounds and 19 consonant sounds—and 24 letters or graphemes. This lack of correspondence between the graphic system and the pronunciation of certain consonants is the primary cause of difficulties in writing and correctly learning Spanish orthography. In contrast, other languages like English present a much more complex orthography due to phonetic inconsistencies and a large number of exceptions. Consequently, English-speaking children require significantly more time and effort to acquire orthographic skills because of the intrinsic difficulty involved in memorizing multiple spellings for the same sound, considering numerous exceptions.

Orthography can be approached from a literal (letters), accentual, or punctual perspective. In the context of this study, we will address a fundamental aspect of initial orthographic learning: literal orthography. To achieve an adequate understanding of literal orthography, it is essential to be familiar with the rules governing the use of letters according to the norms established by the Royal Spanish Academy and the connection between the idealized pronunciation through phonemes and their corresponding letters (Belduma et al., 2020).

For learning literal orthography, traditional approaches are still widely employed by many Primary Education teachers. These approaches involve the verbal or written transmission of rules and exercises to correct errors through phonetic exercises such as dictation or gap-filling, and the correction of poorly written texts using textbooks, and in other cases, workbooks or reinforcement sheets that promote automatization (Gómez, 2007; Bustos, 1995; Martínez, 2004). Although these traditional methods may be effective in the initial stages of learning, their continued use can often hinder the consolidation of correct practical application in students' writing. As Catalá (2009, p. 1) mentions, «traditional orthography teaching does not achieve the fixation of students' learning; in certain practices, instead of preventing orthographic errors, they contribute to solidifying them.»

This traditional approach has been evolving towards a communicative approach based on contextualized learning, where different communicative situations are

proposed, and a holistic reflection is made on the various phonological, morphosyntactic, and pragmatic elements affecting the text. In this context, orthography is one of the elements reflected upon to improve written expression and communicative competence (Barberá et al., 2001; Blanco et al., 2018). These approaches are typically based on active methodologies that favor the design of learning situations where the student must contextualize the application of rules for correct written expression. This requires, in addition to individual effort, fostering collaborative and self-regulated environments and generating direct and active contextualized activities that can be applied in academic, personal, or socio-professional contexts. In such contexts, a much more constructive relationship between theory and practice is established (Espinoza & Campuzano, 2019).

1.2. Characteristics of Effective Mobile Applications for Orthographic Learning

From a socio-communicative perspective grounded in active methodologies, activities based on information and communication technologies, social media microblogging, and gamified activities in various formats such as apps (Romero Oliva et al., 2018), websites (Gómez-Camacho, 2007), chatbots (Vázquez-Cano, 2021), artificial intelligence (Mosqueira-Rey et al., 2023), and interactive quizzes in applications like *Kahoot*, *Quizizz*, *Quizlet*, etc., are being integrated and are increasingly perceived as more necessary by educators (Caballero-Mariscal, 2024). For these resources, particularly mobile applications, to effectively support orthographic learning, they must meet several fundamental characteristics, including adequate data protection, being free of charge, having a clear and direct curricular connection, providing feedback, and being adaptable to the students' learning paces, among other essential requirements (Vázquez-Cano et al., 2023ab).

In the current market, there are various apps available for learning orthography, yet they exhibit different limitations that hinder their proper application in Primary Education: (1) *Wlingua*: This app offers Spanish courses designed for speakers of various levels, including specific lessons on orthography and grammar. The main limitations are the restricted access to content; a subscription is required to unlock all functionalities. It also contains ads in the free version. (2) *Duolingo*: A popular language-learning application that includes Spanish lessons focused on orthography, grammar, and vocabulary. The main limitation is its very limited focus on orthography, as it is more geared toward general language learning. (3) *Learn Spanish Vocabulary*: Primarily designed to improve vocabulary, this app also includes exercises that reinforce correct spelling of Spanish words. The main limitations are that it contains ads in the free version and requires a purchase to remove ads and unlock more content. (4) *Busuu*: This language-learning app offers Spanish courses with orthography, grammar, and conversation exercises. The main limitations are that the free version is limited and requires a subscription to access all content, and it contains ads in the free version. (5) *Lingodeer*: Provides Spanish courses covering orthography, grammar, and vocabulary through structured lessons and interactive exercises. The main limitations are that the full version requires a subscription and it contains ads in the free version. (6) *Memrise*: A language-learning app that includes Spanish lessons with a focus on visual and auditory memory, useful for improving orthography. The main limitations are that the full version requires a subscription and it contains ads in the free version. (7) *SpanishDict*: A reference app for learning Spanish that includes dictionaries, verb conjugators, and lessons on grammar and orthography. The main limitations are that the full version requires a subscription and it contains ads in the free version. (8)

Ortografía Español: A specific app for practicing Spanish orthography through games and interactive exercises. The main limitations are that the full version requires a subscription and it contains ads in the free version.

Generally, these applications share common limitations: many require a subscription to access all their features and contain ads in their free versions. Additionally, not all of them explicitly guarantee data protection or inform if the servers hosting the data are authorized by educational authorities, which is crucial for safe use in educational environments. In this regard, mobile applications designed to teach Spanish spelling must be effectively crafted to maximize learning. Scientific literature underscores several key characteristics these applications should possess: (1) Interactivity: Mobile apps should be interactive, enabling students to actively engage in writing activities, correction, and spelling practice (Kukulska-Hulme, 2016). (2) Immediate Feedback: Immediate feedback is crucial for spelling improvement, allowing students to correct errors promptly (Greene, 2015; Butler et al., 2008; Salas-Rueda et al., 2019). (3) Adaptability: Apps should adjust to each student's competence level, offering exercises and lessons appropriate to their skill level (Clark et al., 2016; Ochoa-Guaraca et al., 2017). (4) Variety of Exercises: Apps should provide a wide array of exercises covering different aspects of spelling, such as accentuation, letter usage, and diacritics, among others (Chen, 2009). (5) Motivation: Gamification elements like rewards and scores can enhance students' motivation to practice spelling (Buckley & Doyle, 2016).

The use of mobile applications for orthographic learning can enhance student autonomy, as their ubiquity allows practice at any time and place (Al-Razgan & Alotaibi, 2022). When these applications are designed with appropriate cognitive scaling, they enable each student to progress at their own pace and focus on areas needing improvement (Pechenkina et al., 2017). Integrating gamification elements, such as achievements and challenges, can further increase students' motivation to practice orthography as if it were a game (Lyytinen et al., 2021). For these applications to be truly effective, they must provide immediate feedback, allowing students to learn efficiently from their mistakes and develop more personalized learning, which is particularly beneficial for those with varying levels of orthographic skill (Papadakis & Kalogiannakis, 2017). Linked to this feedback, tools should also facilitate tracking and evaluation so that students, parents, and educators can monitor progress. This enables the identification of areas requiring more attention and adjustments in the curriculum (Booton et al., 2021). Effective applications are not designed to replace traditional education but rather to complement it by assimilating theoretical-practical concepts that require continuous practice (Meyer et al., 2021).

Furthermore, the integration of mobile applications for orthographic learning in both classroom and home environments provides complementary benefits that amplify their educational impact. While classroom use allows for guided learning under teacher supervision, fostering collaboration and immediate clarification of doubts, at-home use enhances student autonomy and promotes self-directed learning (Arokiasamy, 2017). The flexibility of practicing at home enables students to engage with orthographic exercises at their own pace, adapting to their individual needs and schedules (Al-Razgan & Alotaibi, 2022). Studies show that the combination of these contexts creates a more holistic learning experience, as students can revisit and reinforce concepts introduced in the classroom during home practice (Zaheer et al., 2018). Additionally, home use of gamified applications, featuring achievements and challenges, sustains motivation beyond the structured classroom setting, encouraging

consistent engagement (Lyytinen et al., 2021). This dual-context approach allows educators to leverage technology's adaptability, ensuring personalized feedback and progress tracking, ultimately enhancing learning outcomes (Drigas, & Pappas, 2015). Finally, the use of these digital resources must ensure sustainable and ethical usage, guaranteeing data protection for all users (Vázquez-Cano, 2022; 2023).

1.3. Educational Experience and Research Design

GAUBI is a serious game, designed to facilitate learning of orthographic rules through gameplay. To achieve this, three different game levels have been designed, each corresponding to distinct pedagogical functions.

First Level: This level is the most mechanical and aims to exercise basic cognitive functions such as recognition and identification of elements, attention, and memory. This is accomplished through Arcade-type game mechanics, fostering an automatism connected with the gameplay itself.

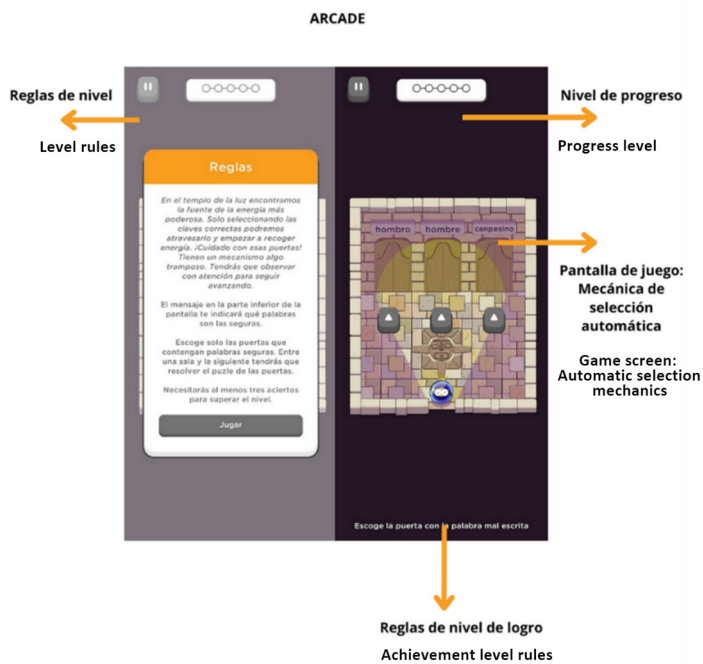


Figure 1. Level 1 of the game (Arcade).

Second Level: We aim for an exploratory phase involving decision-making regarding the sequence of selecting elements and completing challenges. Here, cognitive function expands to include association and linking of ideas, implementing learned concepts through various game mechanics such as selection, deletion, and more.

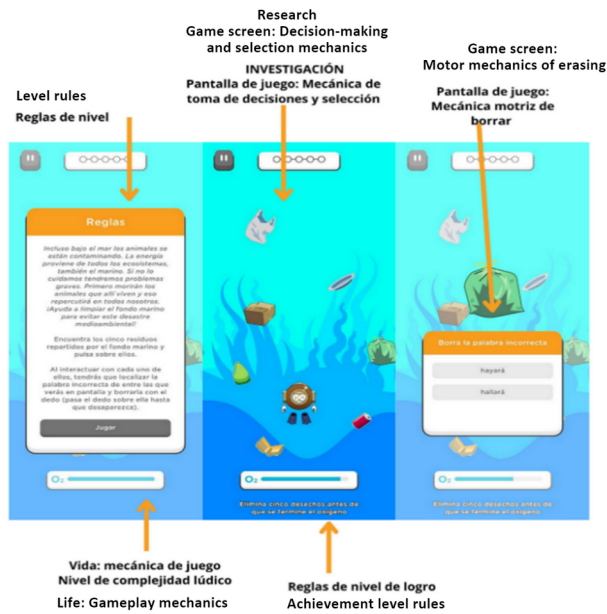


Figure 2. Level 2 gameplay (Research).

Third Level: Grounded in metacognitive processing, this level aims to encourage students to apply and create content independently. Students make decisions within an interactive fiction framework that allows them to complete the storyline based on mental health (SDG).

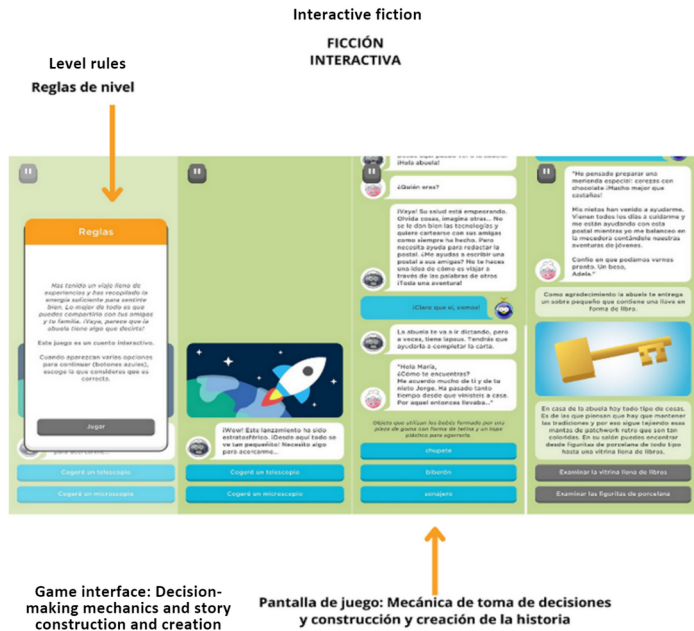


Figure 3. Level 3 gameplay (Interaction-Creation).

In all levels, there are three achievement levels marked by stars where mechanics and rules change:

- a) The first level involves identifying the correct answer.
- b) The second level involves identifying the incorrect answer.
- c) The third level involves distinguishing the correct answer from common errors that primary school students often confuse. Additionally, each level has 5 progress points displayed at the top, which light up in green/red depending on whether the answer was correct or incorrect.

In some levels, an additional gameplay element is introduced in progress, involving a «life» mechanic to increase the difficulty of the second level of gameplay. Figure 4 illustrates the progression map through different games and themes. Below is an example of students working in the classroom with the GAUBI app (Figure 5).





Figure 4. Game development roadmap.



Figure 5. Students playing the GAUBI app.

The control group students employed a traditional method consisting of exercises and spelling worksheets derived from the Santillana textbook, as depicted in Figure 6.

7 Completa las oraciones con palabras con *h*.

• La _____ cubre el muro. • El indio hace señales de _____.

8 Escribe oraciones con palabras que empiecen por *hue-*.

9 Rodea en cada serie la palabra intrusa según el acento.

- lágrima, círculo, azúcar, máquina
- carpeta, musical, móvil, problema
- nariz, reloj, mantel, antes
- trébol, botón, cajón, avión

11 Completa.

c	qu	• _____aramelo	• _____iniela	• bo_____erón
g	gu	• a_____ua	• al_____uno	• ju_____ete
r	rr	• son_____isa	• hon_____ado	• te_____aza

12 Escribe tres palabras con cada sonido.

Sonido G suave	Sonido J	Sonido Z
_____	_____	_____
_____	_____	_____
_____	_____	_____

Figure 6. Traditional spelling worksheets and exercises model.

2. Method

The study involved the use of the GAUBI app for practicing spelling content in fourth and fifth grades of primary education across various Spanish schools, within the context of a proof-of-concept to evaluate the effectiveness and functionality of the GAUBI app in teaching spelling during the academic year 2023/24. The research design aims to address the following questions:

1. Which of the three methods for practicing spelling is most effective in students' academic performance?
2. To what extent does the integration of a serious game for spelling practice enhance learning outcomes when used in the classroom compared to its use at home, and how do both settings compare to a control group?

The study employed a quasi-experimental quantitative framework utilizing a pretest-posttest design with convenience sampling. Initially, the normal distribution was assessed using the Kolmogorov-Smirnov Test. Subsequent to this, potential disparities between the pretest and posttest outcomes were scrutinized employing ANOVA and ANCOVA methodologies (Rosenthal & Rubin, 1982). Additionally, BESD (Binomial Effect Size Display) was employed to present the outcomes across spelling categories (Rosenthal, 1991).

2.1. Experimental process

Prior to the experiment, learners received two instructional sessions on using the GAUBI app. Subsequently, they completed pre-tests and pre-questionnaires. The experimental groups (EG1 and EG2) received 40 minutes of instruction using the GAUBI learning system, in which the difficulty of the spelling minigames increased as the learner's cognitive ability improved. Learners could only advance to the next level upon achieving the predetermined goal; otherwise, they were required to repeat the appropriate level until they attained the necessary knowledge. The app was implemented over a three-week period, with students engaging in 15-minute sessions each week. This resulted in a total of 15 classroom sessions and 225 minutes of gameplay, providing ample time for interactive learning and skill development. Depending on the mini-game in which students were engaged, the gameplay occurred individually, in pairs, or in groups of four. The estimated distribution of game modes during the classroom sessions was as follows: 50% of the time was spent playing individually, 25% in pairs, and 25% in groups of four. In contrast, control group 1 (CG1) practiced spelling using a traditional learning system based on paper activities with teacher guidance. At the end of the learning session, all learners were required to complete a 45-minute post-test and post-questionnaires.

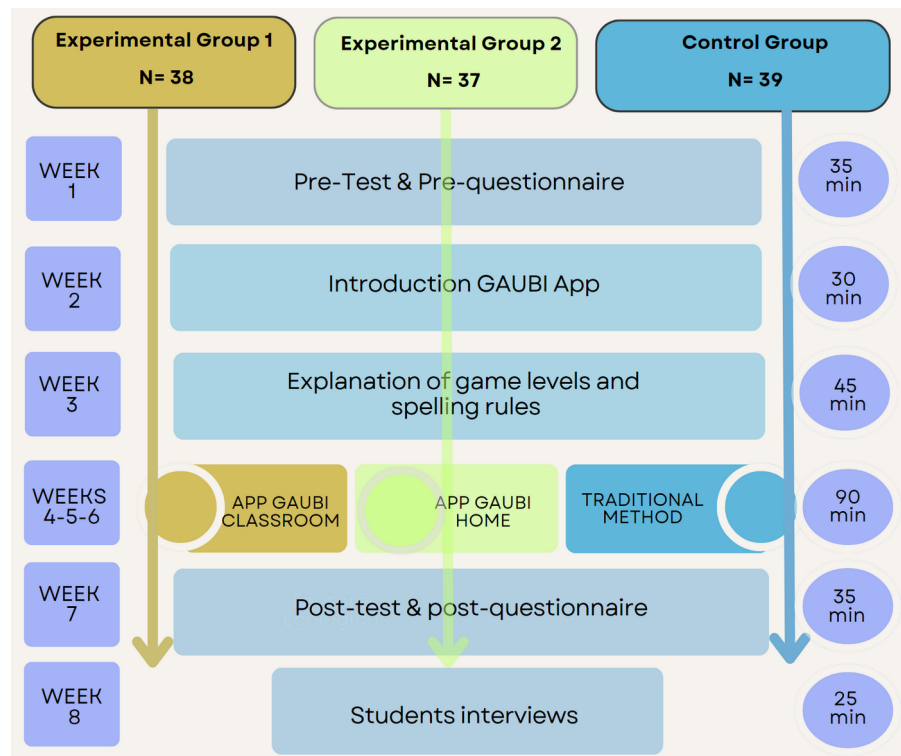


Figure 7. illustrates the experimental process in this study.

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The first week of the research was dedicated to conducting a spelling proficiency test focusing on letter orthography. The test comprised three parts: a dictation of 100 words, correction of a dictation with 100 misspelled words, and a third exercise where students had to choose between two options of correctly and incorrectly spelled words to complete a sentence. During the second and third weeks, students were introduced to the GAUBI app, including its features, functionalities, avatars, and gameplay mechanics. Students and families were informed of the maximum allowed usage time of 15 minutes per session in both the classroom and at home during the three-week duration of the study. An 8-inch tablet was used in the classroom, while at home, students used devices available to them (n=18 smartphones from parents / n=10 tablets, all of which were 8-inch tablets used in the classroom). Since both parents and students were informed about the procedure, the game-based activity was conducted autonomously by the students at home, adhering to the established time limits and without any assistance from other family members. In the fourth, fifth, and sixth weeks, theoretical and practical explanations were conducted in three different formats: Group 1 used the app in class, Group 2 used the app at home, and the control group used traditional exercises, worksheets, and dictations. Three different teachers participated, with an average age of 37.2 years, comprising two females and one male, each with over 7 years of teaching experience. Post-tests were conducted in the seventh week to assess students' progress, followed by interviews with students in the eighth week.

2.2. Participants

The participants in this study were fourth graders from six classes in three primary schools in Spain, which were automatically divided into three groups according to the method used to practise the spelling EG1 (App-Gaubi-Classroom), EG2 (App-Gaubi-Home), and CG1 (Traditional exercises-Classroom-Home). The study sample comprised 114 students (9-10 years old). To check whether the sample size was reasonable, a post hoc statistical power analysis was conducted using the G*Power 3.1 software (Faul et al., 2007). The calculated power value was 0.88, more than the basic level value of 0.80. Hence, the sample size of the present study was in line with the statistical requirements. Besides, every participant in this experiment was informed that he or she was allowed to withdraw at any stage, with no negative impact on the schooling. The experiment used anonymous methods to collect data and protect personal information. All data were only used for research purposes and would not affect the

participants' studies and lives. In addition, the research has obtained the approval of the committee for projects involving human research of the Universidad Nacional de Educación a Distancia (Reference: 40-SISH-EDU-2023).

2.3. Instruments

The primary objective of the pre-test was to evaluate learners' prior knowledge of Spanish spelling. In contrast, the post-test aimed to assess their learning outcomes following the completion of the corresponding instructional methods. Both tests were comparable in complexity and comprised identical question types and scoring systems. Each test had a maximum score of 100 points, including 15 multiple-choice questions (30%), two texts for identifying spelling errors (30%), ten fill-in-the-blank questions (20%), and two spelling dictation tasks (20%). Two experienced Spanish teachers collaborated in developing the test content, which was validated by a third teacher to ensure validity and reliability. All three teachers reached a consensus to confirm that the pre- and post-test content adequately assessed the learners' proficiency. The Cronbach's alpha values for the pre-test and post-test were 0.81 and 0.83, respectively, indicating acceptable internal consistency (Cortina, 1993). The semi-structured interview questions consisted of 15 likert questions (e.g., «I prefer playing the app over doing written spelling homework at home». «With the app, I feel more motivated to learn spelling»). The Cronbach's alpha value was 0.89. Two open questions were added to measure the most positive and negative aspects of the experience (<https://forms.office.com/e/KJr6RsGy1X>).

3. Results

First, normality (Table 1) and homogeneity of variances (Table 2) were calculated to ensure that ANOVA and ANCOVA tests could be conducted.

Table 1. Test of Normality.

	Group	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pre-test Score	Control	.121	9	.200*	.946	9	.758
	Exp. 1-2	.132	9	.201	.941	9	.832

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction.

It is verified that the dependent variable must be normally distributed for each combination of factors and covariates.

Table 2. Test of Homogeneity of Variance.

		Levene Statistic	df1	df2	Sig.
Pre-test Score	Based on Mean	1.475	3	32	.384
	Based on Median	1.269	3	32	.307
	Based on Median and with adjusted df	1.269	3	29.933	.307
	Based on trimmed mean	1.477	3	32	.382

The learners' pre-test results revealed that the three groups had equivalent levels of Spanish spelling proficiency prior to the experiment ($F_{(2,111)} = 2.94, p = 0.06 > 0.05$). The sample displayed a normal distribution, as indicated by the Kolmogorov-Smirnov test ($D = 0.07, p = 0.21$). Furthermore, the homogeneity of regression slopes was confirmed ($F = 1.11, p = 0.33$), demonstrating that ANCOVA analysis could be appropriately applied.

The ANCOVA analysis of the learners' spelling achievement is presented in Table 3. There was a significant difference in spelling achievement among the three groups ($F(2,111) = 10.10, p = 0.000 < 0.001$). Post hoc analyses using LSD tests revealed that learners in EG2 had significantly higher spelling acquisition than those in CG1 and EG1. Additionally, CG1 performed significantly better than EG1. These results indicate that practicing spelling with the GAUBI app significantly enhanced learners' spelling acquisition compared to using the app in the classroom (EG1) or traditional paper activities at home (CG1).

Table 3. The ANCOVA result of the practicing spelling.

Variable	Group	N	Mean	S.D	Adjusted-mean	F	Post-Hoc
Post-test	(1)EG2	37	83.41	13.99	81.72	10.101***	(1)>(2)
	(2)CG1	39	72.72	16.71	75.11		(1)>(3)
	(3)EG1	38	69.82	19.89	66.51		(2)>(3)

***P<0.001

To identify the importance of the effect of the EG2 (App-Gaubi-Home), we present the Binomial Effect Size (Table 4). The average scores are depicted alongside the Cohen's d effect size and the correlation coefficient (r) to measure the magnitude of the intervention effect and the strength of association, respectively. The results underscore that the intervention implemented in EG2 (0,56) was the most effective in enhancing orthographic skills, as evidenced by the higher mean scores and the greater effect size. This implies that the strategies utilized in EG2 should be further explored and possibly integrated into broader educational practices. Below, the box plot of the post-test results for the three groups is presented in Figure 8.

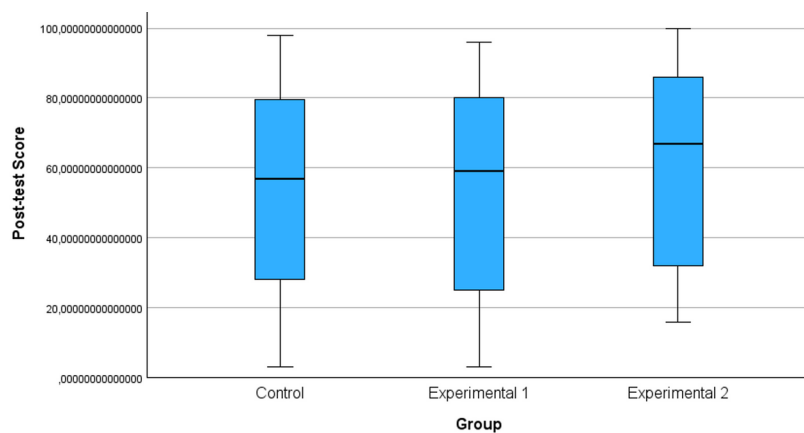


Figure 8. Boxplot graph experimental and control group comparison.

Table 4. Binomial Effect Size Displays of spelling categories.

Spelling categories	EG₂ Mean	EG₁ Mean	CG₁ Mean	Game Levels
Words with za/ce/ci/zo/zu	78	75	70	Arcade
Words with ca/que/qui/co/cu	80	78	75	Arcade
Words with ge/gi/je/ji	72	70	65	Arcade
Words with ga/gue/gui/go/gu/güe/güi	87	85	80	Arcade
Words with br and bl	82	80	75	Arcade
Words with bu-, bur-, bus-	76	74	70	Arcade
Words with hie- hue-	85	83	78	Arcade
Always write m before p and b	79	77	73	Arcade
Write c before e/i	74	72	68	Research
Write qu before e/i	80	78	74	Research
Words ending with -d or -z	86	84	79	Research
Words with ll	81	79	75	Research
Words with g	77	75	71	Research
Words with j	82	80	76	Research
Words with gu or gü	84	82	77	Research
Words with r/rr	88	86	81	Research
Words with b	79	77	73	Research
Words with h	83	81	76	Research
Words with y	87	85	80	Research
Forms ending in -aba	89	87	82	Research
Words with initial b	78	76	72	Research
Words with x	75	73	69	Research
Words with v	82	80	76	Research
All the rules	84	82	77	Interactive Fiction
Cohen's d	0.56	0.42	0.44	
r	0.27	0.20	0.21	

The findings indicate that experimental group two (EG2) achieved the highest effect size (0.56), suggesting that a blended approach incorporating the app is more effective for orthographic learning than traditional paper-based methods or using the app exclusively in the classroom. Using the app at home offers distinct advantages over classroom-only or paper-based learning. Home use allows students to practice at their own pace, reinforcing skills beyond the constraints of classroom time.

Moreover, the app's variety of mini-games provides a broad spectrum of orthographic challenges, facilitating the development of both foundational and complex skills. This independent learning model encourages self-regulation, which is essential for fostering deeper engagement and mastery. It enables students to revisit and reinforce difficult concepts at their convenience, supporting sustained learning. Such continuous, out-of-class practice bridges the gap between theoretical knowledge and practical application, ultimately enhancing long-term retention and skill acquisition.

4. Discussion

Gamification and serious games have become popular tools in education, especially in teaching first and second languages. This research has focused on evaluating whether didactic strategies based on serious games can significantly enhance Spanish spelling learning among primary education students. We have observed that the methodological approach yielding the most significant results involves using the application as a complement to traditional homework in printed or audiovisual formats. This approach is characterized by its ubiquity, mobility, and gamification through cognitive scaling based on spelling challenges, which also provides learning analytics. This enables feedback and guidance for student learning while ensuring data protection and the ethical, sustainable use of the application. Additionally, the challenges and mini-games have been designed to address the treatment of Sustainable Development Goals integrated with the development of spelling competence.

The results indicate that experimental group 2 improved the spelling component related to letter accuracy through the lexical content introduced in the app and the audiovisual format for word identification. In this regard, other studies have shown that gamification can enhance the acquisition of new vocabulary and retention of new words, as students prefer these approaches over more traditional methods such as printed worksheets or flashcards (Ahada, 2021; Yu, 2023). Another fundamental element underpinning the app's development is game-based learning, which gamifies aspects of learning that require extensive practice, and which traditional methods struggle to sustain student attention and motivation. The use of games, even if not inherently serious, can also help increase motivation, attention, and positive attitudes toward language learning, as recently highlighted in studies on the educational use of the popular game 'Among Us' (Casanova-Mata, 2023). Therefore, gamification has proven effective in teaching various aspects of language, including grammar and overall linguistic proficiency, suggesting it may also be beneficial for improving spelling practice (Wen, 2023; Brazo Millán et al., 2018).

The ludified approach to spelling combined with traditional methods has a positive impact on competencies related to writing, composition, pronunciation, and text interpretation (Tovar Rua et al., 2024). By employing techniques that enhance attention, motivation, and visual memory, improvements in visual attention and memory are achieved (Paredes, 1997, p. 616), while reducing rote learning of unnecessary spelling rules in primary education in favor of continuous practice on manifest errors in common letters and words (Carratalá, 1997). Another challenging aspect in improving correct spelling acquisition is the necessary evaluation and feedback from teachers, which often proves difficult. Tools like the one analyzed in this study enable feedback from families and teachers by providing student performance reports linked to assessment criteria established in the curriculum. In this sense, it adheres to the recommendations set forth by Cassany et al. (1994, p. 415): «the spelling points that are necessary for each group of students should be addressed according to their knowledge and difficulties.»

Different studies demonstrate that the use of mobile applications across both home and school environments fosters continuous learning and facilitates the development of a cohesive and integrated educational experience (Camilleri &

Camilleri, 2019). This dual-context approach enhances learning outcomes by blending structured, teacher-led instruction with opportunities for independent exploration. Meyer et al. (2021) underscore the importance of classroom-based use, where educators can provide scaffolding, immediate feedback, and opportunities for collaboration, which collectively support the development of critical cognitive and interpersonal skills. Complementing this, research by Khaddage et al. (2016), Cruaud (2018), and Murray (2014) highlights the benefits of at-home use, which enables learners to study autonomously, engage at their own pace, and revisit challenging material—key factors for reinforcing knowledge and fostering self-regulation. Additionally, Papadakis and Kalogiannakis (2017) emphasize that linking structured classroom learning with the gamified, flexible features of mobile applications enhances motivation and engagement. This alignment enables students to apply and deepen their understanding in diverse settings, ultimately maximizing the educational impact of mobile learning technologies.

Another aspect where games have demonstrated greater effectiveness is when they are linked to challenges based on research, interaction, and creation (Somoano García et al., 2018). Primarily, through metacognitive processing aimed at applying and creating content by students, making decisions in an interactive fiction that allows them to complete the story based on mental health (SDGs). Several authors have shown the effectiveness of certain didactic strategies based on technology to improve spelling learning that enable the application of theoretical knowledge through visual, auditory, playful, and above all, dynamic content that generates greater motivation among students (Chaverra-Fernández et al., 2016; Guamán Paida, & Álvarez Lozano, 2022).

5. Conclusion

This research has clearly demonstrated that the use of the GAUBI app for teaching spelling can enhance student motivation and the acquisition of literal spelling skills through a cognitive scaling approach with different levels of interaction using arcade-style games, research, and interaction. These elements allow spelling practice to be addressed from a playful perspective linked to the curriculum, with an ethical and responsible approach to data protection and integration with other cross-curricular elements such as Sustainable Development Goals. Furthermore, the application facilitates feedback on the teaching-learning process and provides teachers and families with student progress reports, enabling support and enrichment of aspects that may have been limited in the development of spelling learning through gameplay.

Undoubtedly, at this educational stage, students not only need to know spelling rules but also understand their application in various contexts. This requires continuous practice enriched through diverse methodologies that sustain constant engagement without generating boredom due to the typology of exercises and activities linked to spelling work. When spelling skills are solidified in these formative years, the benefits are substantial: students gain confidence, minimize errors, and foster correct language use regardless of the printed or digital context, ultimately improving both linguistic competence and communicative skills among primary education students.

Availability of data and materials

The dataset of the study can be consulted in the following link (Harvard Dataverse: <https://doi.org/10.7910/DVN/BOUQSM>)

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Ethics approval and consent to participate

The research has obtained the approval of the committee for projects involving human research of the Universidad Nacional de Educación a Distancia (Reference: 40-SISH-EDU-2023).

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