Substantivando: An Educational Game for Teaching Nouns in Elementary School

Desirée Xavier da Costa[1], Williane Gabriele S. Pereira[1], Pedro Dimas da C. Lima[2]
Suellen Trindade dos Santos[2], Leonardo da C. Estevam[1], Paulo André I. Pontes[2]
José Guilherme dos S. Fernandes[1], Marcos Cesar da R. Seruffo[1]

[1]Universidade Federal do Pará (UFPA)
Belém – PA – Brazil

[2]Instituto Federal do Pará (IFPA)
Ananindeua – PA – Brazil

desiree.costa@itec.ufpa.br, willianepereira44@gmail.com

{cunhapedro665, s.trindadedossantos, leonardoestevam0506}@gmail.com

paulo.pontes@ifpa.edu.br, guilherme.profufpa@gmail.com, seruffo@ufpa.br

Abstract. *Teaching nouns in Elementary School presents various challenges, and gamification emerges as a promising strategy to overcome them, promoting playful and effective learning. This work presents the gamified educational game "Substantivando", which combines quizzes, scoring systems, and immediate feedback to enhance students' learning. The game was validated with 26 students through a questionnaire adapted to evaluate the quality of the educational game, focusing on the dimensions of motivation, user experience, and learning effectiveness. The results indicate that "Substantivando" not only supports the teaching of nouns, but also enriches the educational process by providing a stimulating, fun, and enriching learning experience.*
Keywords. *Educational game, Nouns, Quiz, Gamification, Education*

1. Introduction

The noun is a grammatical class that names various things, whether real, imaginary, animate, concrete, or abstract. According to the National Common Curricular Base (from Portuguese, "Base Nacional Comum Curricular" - BNCC)[1], nouns are one of the first classes taught in Elementary School, when their structure and their relationship with other grammatical classes within a sentence are introduced, a study that continues throughout the school journey. Due to this relationship, nouns are responsible for creating cohesive sentences, what makes them indispensable for writing [Francisconi 2020]. Their understanding in Elementary School is crucial, as this grammatical class relates to others for the formation, agreement, and meaning of statements [Silva 2022].

However, although understanding nouns is necessary, teaching them through a traditional approach can demotivate students by relegating them to a passive role of merely listening and repeating information. Furthermore, traditional methods no longer meet the needs of a generation increasingly immersed in the digital world, accustomed to other ways of relating and transmitting information

[1]Available at: http://basenacionalcomum.mec.gov.br/

[da Silva et al. 2018, de Almeida Brochado e de Carvalho 2021], making it necessary to adopt new methodological tools to enhance the teaching-learning process and expand the ways of accessing knowledge [Victal et al. 2015].

Alternatively, Digital Game-Based Learning (DGBL) is a contemporary method widely used in various teaching areas [Yang et al. 2024, Amzalag et al. 2024, Zhou e Bakhir 2024]. This method consists of a practical and interactive approach that combines digital games and educational content, making the teaching-learning process more dynamic and interesting for students [Anastasiadis et al. 2018, Miranda et al. 2023]. Among the main advantages of DGBL are: (i) ease of learning with the use of visual elements that aid in content assimilation; (ii) development of cognitive skills such as critical thinking and decision-making; and (iii) motivational effect that provides immersion, fun, and entertainment [Paiva e Tori 2017, Barz et al. 2024].

As an application of DGBL, educational games are teaching and learning tools used both in the classroom and external environments, aimed at promoting the understanding and assimilation of knowledge, as well as stimulating skill development [Schünemann e Garcia 2023, Uzeda et al. 2023]. In addition to educational games, gamification is also an implementation of DGBL, which consists of using components, mechanics, and dynamics of digital games in other contexts, with emphasis on its application in the educational field [Morais e Melo 2021]

In the literature review works conducted by Costa et al. (2018) and da Silva Neto et al. (2023) , various gamification elements used in education were highlighted and identified, including reward systems, personal profile (Avatar), interaction, immediate feedback, scoring, tutorial, ranking, among others. In both studies, the review demonstrated that gamification can be of great assistance to students' academic success. Thus, both gamification and educational games are important resources as they help enrich and diversify the methods of knowledge transmission and acquisition.

In this context, this work presents "Substantivando", a gamified educational game developed to offer the following contributions: *(a)* assisting and enhancing the teaching and learning of nouns, establishing a solid foundation on their structure for elementary education; *(b)* serving as an additional support tool in the educational process; and, finally, *(c)* providing stimulating, fun, and interesting learning through an educational game. In addition to presenting the tool, the work also presents the results of the application's evaluation, which was adapted according to the models proposed by Savi et al. (2010) and its extension in Savi et al. (2011), which analyzes whether the game fulfills its role in motivating students, achieving its learning objectives, and promoting a good user experience.

This work is structured as follows: Section 2 details related works, Section 3 presents the application, Section 4 describes the evaluation and results, and finally, Section 5 discusses the conclusion.

2. Related Works

Technology plays an essential role in educational transformation, offering innovative tools that assist teachers in the pursuit of more dynamic and effective teaching. In this section, notable works addressing tools, developed with an emphasis on education and the teaching of the Portuguese language, are presented.

"The Secret of the Castle" is a 2D game developed in the Java programming language, designed to assist in the learning process of Brazilian Sign Language (from Portuguese, "Língua Brasileira de Sinais" - Libras) and Portuguese. In this game, users control a character named "César", a teacher who seeks celestial rubies in a castle, which serves as the main scenario of the game. Throughout the story, the character must face challenges and solve puzzles in Libras and Portuguese [Ramos et al. 2014].

Mellos (2014) created a digital game to strengthen the learning of grammatical classes, such as adjectives, adverbs, verbs, and nouns, among others. In the game, a grammatical class is randomly chosen, and then, the user is instructed to collect several words that are in the scenario, selecting the three words that belong to the chosen grammatical class. The player has three attempts for this, and if they don't succeed, it is necessary to restart the game. To win, the user must complete the five phases corresponding to the grammatical classes present in the application.

The game "Collective Noun Hunt" was developed to assist elementary and middle school students in learning about collective nouns. It is a 2D game in which users control a character using the arrow keys on the keyboard. The objective is to capture the collective nouns requested during the game [Graciano et al. 2018].

In light of these approaches, it is evident that gamification can be extremely beneficial in the learning process, as it can make studying more dynamic and motivate students. Furthermore, from the survey's findings, the absence of applications that specifically address the grammatical class of nouns comprehensively is apparent, with Mellos' (2014) work addressing nouns in a very general way and "Collective Noun Hunt" only focusing on one classification of nouns.

Therefore, it is clear that Substantivando stands out from the aforementioned works because it is a game entirely focused on teaching nouns, with their classifications and inflections presented completely and in detail. Additionally, Substantivando distinguishes itself by providing explanations before each stage, aiming to enhance players' understanding.

3. Development of the Game Substantivando

For the development of the game, a bibliographic analysis of several literature reviews work on the use of gamification elements in education was first carried out, such as: [Deterding et al. 2011, Costa et al. 2018, Laine e Lindberg 2020, Tyni et al. 2023, da Silva Neto et al. 2023, Lampropoulos et al. 2024]. This study aimed to understand the essential elements of gamification and analyze its effects on students.

After this analysis, the application planning proceeded. At this stage, sketches of the application screens were created, aiming to provide a clear and initial visual representation of the tool's structure and design [Baltes e Diehl 2014]. For this task, the support of an experienced elementary school teacher was sought, who contributed mainly to planning the noun content in the drafts, including explanations, questions, and answers. Additionally, the sketches also considered the tool's design and how gamification elements would be presented in the application. The Canva editing software[2]

[2]https://www.canva.com

was used to develop the visual prototypes, due to its ease of use, free availability, and variety of ready-made graphic templates.

After the analysis, the development of the game began, including its functionalities and the aspects addressed in the prototyping phase. For this, the Unity3D platform[3] was used, selected due to the availability of various ready-to-use libraries and the ability to compile games for different platforms.

The production process of Substantivando lasted 5 months and did not require external funding, as it was carried out without any financial cost. The entire development was guided by two post-doctoral professors, supported by two undergraduate scholarship students and a master's student, along with the collaboration of an external elementary school teacher, who was responsible for organizing the content about nouns, as previously mentioned. The game is now finished and currently operates on the Android platform. The screens and functionalities of Substantivando are detailed in subsections 3.1, 3.2, and 3.3.

3.1. Initial Screens

Substantivando begins with a loading screen, commonly referred to as a splash screen[4], which serves as a visual introduction before the game begins, as illustrated in Figure 1(a). Subsequently, the players are presented with the initial screen of the game (Figure 1(b)), which, along with the "Jogar" (Play) and "Ranking" buttons, also exhibits a tutorial (Figure 1(c)). This tutorial provides a simplified explanation of the main game screens and their functionalities, aimed at facilitating the understanding of the target audience.

Figure 1. Initial screens; (a) Splash screen; (b) Initial screen with the Play, Ranking, and Tutorial buttons; (c) Game tutorial; (d) Theme selection screen with the theme "1-What is a noun?" selected

The screen following the "Jogar" (Play) button, shown in Figure 1(d), displays themes numbered from 1 to 9, which divide the content according to the standard classifications and inflections of Portuguese nouns. These themes are organized in the following order: 1 - Concept of Noun, 2 - Collective Nouns, 3 - Common and Proper Nouns, 4 - Concrete and Abstract Nouns, 5 - Primitive and Derived Nouns, 6 - Simple and

[3]https://unity.com
[4]https://www.simform.com/mobile-patterns/blog/splash-screen-mobile-app-launch-experience/

Compound Nouns, 7 - Gender (Feminine and Masculine), 8 - Degree (Augmentative and Diminutive), and finally, 9 - Number (Singular and Plural). This subdivision, applied in the didactic book [Ferreira da Cunha e Lindley Cintra 2013], provides a comprehensive understanding of each category individually, offering dedicated explanations and allowing for a more specific assessment of areas where players might have learning difficulties.

3.2. Explanation and Quiz Screens

Upon selecting a theme, the player is taken to a screen that contains a specific explanation for the chosen theme. This explanation is a summary of the information about the topic that will be practiced in the subsequent questions. To aid in learning and enhance the playful experience for students, simplified and direct explanations were implemented, featuring examples and graphical elements for each case. For example, Figure 2(a) shows how the explanation of number inflection is presented in Substantivando.

After reading the explanation, the students are taken to direct multiple-choice questions about the chosen theme, known as quizzes [Lampropoulos et al. 2024], to test the absorption of the knowledge acquired on the previous screens and in the classroom. As shown in Figure 2(b), the structure of the questions aims to assess the application of knowledge in identifying words that correspond to the content of the chosen theme.

Substantivando also features an immediate feedback system, indicating to the player whether they answered correctly or incorrectly, right after their response, as shown in Figure 2(c) and (d). Additionally, in the case of an incorrect answer, the reason for the error is specified, thus allowing for continuous and dynamic evolution of the user's knowledge [Fu e Li 2022], enabling them to learn in real-time, which contributes to a sense of control [Ajogbeje 2023].

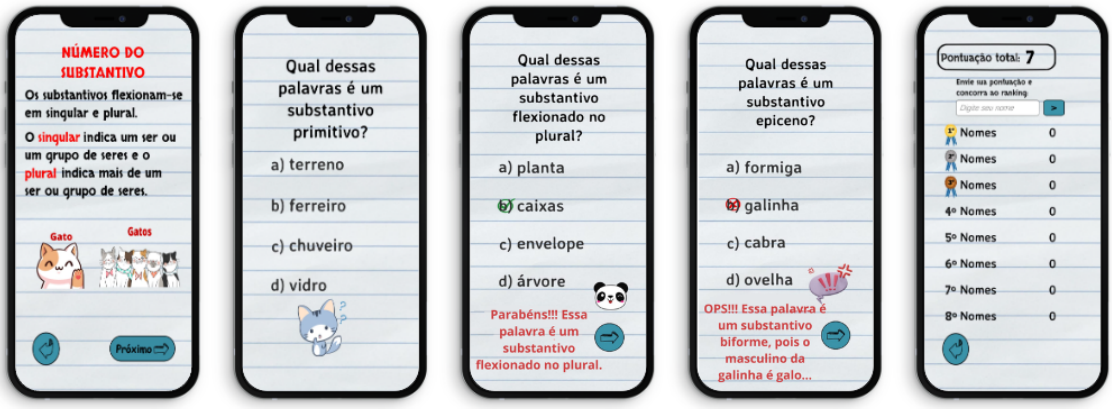

Figure 2. Game screens; (a) Explanation screen talking about the Number inflection with a cat (singular) and cats (plural) as an example; (b) Question about Primitive nouns; (c) Congratulations screen that appears after answering a question correctly; (d) Feedback screen that appears after answering a question incorrectly; (e) Ranking screen with 10 names

3.3. Scoring and Ranking

The use of reward systems is a fundamental element of gamification, as it aims to encourage players to improve their performance playfully by offering them something

in return and allowing them to see how much they have progressed in the game [Costa et al. 2018]. The scoring system adopted by Substantivando is straightforward and quantitative, with the player's overall score being the sum of their highest count of correct answers in each theme, where each correct answer adds 1 point. Therefore, to increase their score, the user must answer questions they previously got wrong. This stems from the trial-and-error method, which involves making a series of attempts to solve any type of challenge, during which the individual learns from mistakes until they achieve the correct solution. This method is essential for promoting critical thinking and problem-solving in educational environments [Jonassen 2000].

The software also features a ranking system that allows users to check their placement relative to others based on their score and encourages engagement through competition [Hanus e Fox 2015, Costa et al. 2018]. This functionality is valuable for helping users track their progress and achieve their personal goals [Dichev e Dicheva 2017]. The ranking, as shown in Figure 2(e), consists of the top 10 players with the highest scores who have submitted their names, a process that can be done at any point in the game using only the desired username. In the context of a classroom with elementary school students, the presence of this element can make the game more dynamic and use competitiveness as a motivational tool for learning.

4. Results and Evaluation

The evaluation of Substantivando was conducted at a municipal public school located in an urban area, with 5th-grade elementary school students. This location was chosen because it is where the teacher who assisted in the planning of Substantivando works. The evaluation involved 26 students, aged between 9 and 11 years, who agreed to participate in the study and whose guardians authorized their participation by signing the Free and Informed Consent Form (from Portuguese, "Termo de Consentimento Livre e Esclarecido" - TCLE)[5].

Initially, the evaluating teacher conducted a lecture and discussion about nouns, followed by a presentation of the game, demonstrating its features and screens to the students. After the presentation, the students were invited to play the game. To assist in this process, the institution, together with teachers and interns, provided 5 mobile devices for use and had 3 interns available for monitoring and support activities. Due to this limitation of resources to serve the entire class at once, a rotation of 5 students at a time was organized. After some time of individual use, the teacher organized usage in pairs, observing greater collaboration and mutual learning among the students.

After using the game, the students were invited to complete a questionnaire inspired by and adapted from the evaluation models proposed by Savi et al. (2010) and its extension by Savi et al. (2011). These models were chosen because they emphasize the analysis of the quality of educational games and the students' perception after their use; in addition, they allow for the verification of whether the game promotes the advantages of the DGBL method. Both models consider that a quality game is one evaluated across three essential dimensions. The first dimension, **motivation** (see subsection 4.1), assesses the game's ability to motivate students. The second dimension, **user experience** (see subsection 4.2), analyzes whether the game provides positive experiences

[5]Available for viewing at: https://bit.ly/TCLE-Substantivando

for students. Finally, the **learning** dimension (see subsection 4.3) evaluates whether the game successfully achieves its educational objectives.

In this last dimension, an additional approach mentioned in Savi et al.'s (2011) model was included in the questionnaire and is explained in subsection 4.3. Each dimension has its questions with responses varying on a Likert scale from -2 (Strongly Disagree) to +2 (Strongly Agree) [Likert 1932]. Besides the aforementioned dimensions, the questionnaire also included **descriptive questions** (see subsection 4.4) to provide more detailed feedback on the game. In addition to the responses from the 26 students who completed all sections, the questionnaire also included contributions from 2 interns and 2 teachers, who only answered the motivation and user experience dimensions. Their feedback was considered valuable because they work in the field of teaching Portuguese, enriching the analysis in these dimensions.

More clearly, the dimensions of motivation and user experience received a total of 30 responses, while the learning dimension, which only considered the students' opinions, had 26 responses. The results of the questionnaire responses will be presented in subsections 4.1, 4.2, and 4.3.

4.1. Motivation

According to the ARCS model proposed by Keller (1987), people are motivated to engage in an activity when they perceive that it can satisfy their personal needs (value) and when they have a positive expectation of success in performing it (expectancy). Based on this, the motivation dimension in the questionnaire analyzes users' views on the utility of Substantivando, as well as their perceptions of success when interacting with the game.

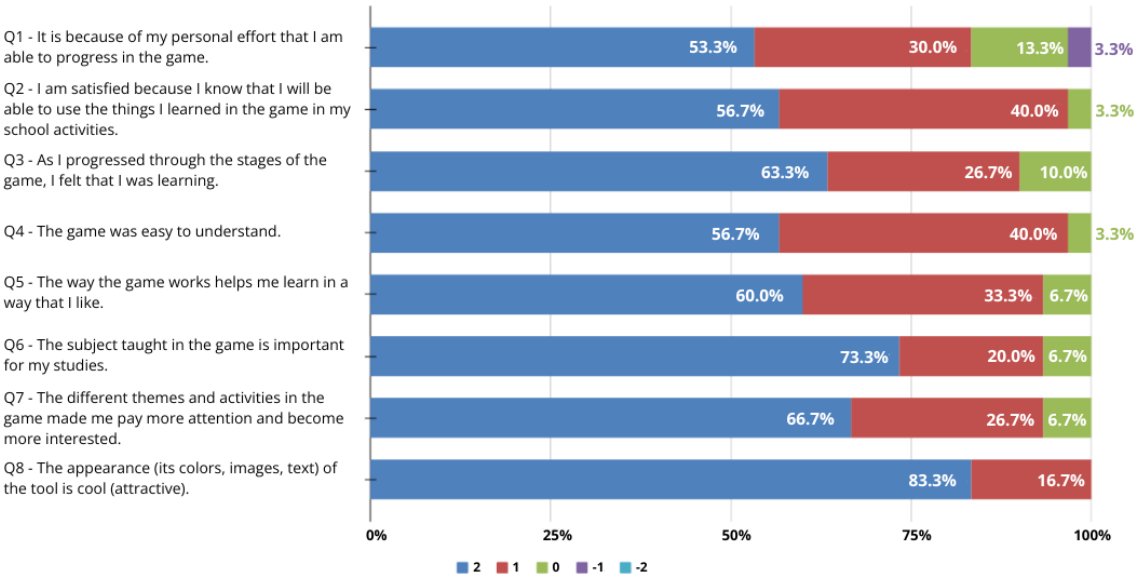

Figure 3. Results of the Motivation Dimension

As shown in Figure 3, there is a significant concentration of positive responses across all the questions. Notably, 83.3% of participants agreed with question Q1, while 96.7% agreed with questions Q2 and Q4. Similarly, 90% agreed with Q3, 93.3% with questions Q5, Q6, and Q7, and 100% agreed with Q8. In summary, in all questions,

more than 80% of participants gave ratings of +2 and +1, demonstrating a high level of satisfaction with the game. The results highlight the importance and utility of the game in the learning context, adding value to the users, and also show the users' positive perceptions of success when interacting with the game. Together, these findings indicate, according to Keller's model, the capability of Substantivando to motivate players. However, despite the positive results, there was a -1 rating in Q1, which will be considered by the authors in future developments of the research.

4.2. User Experience

Although it is a fundamental concept in the study of Human-Computer Interaction, User Experience (UX) carries different interpretations [Barbosa et al. 2021]. For this work, the definition proposed by Calvillo Gámez (2009) is adopted. According to the author, experience is created by a process of user interaction with the elements and properties of a tool, and the result of this experience can influence the user's emotional state and mood, being able to generate satisfaction and positive interactions. Therefore, the UX dimension in the questionnaire seeks to analyze Substantivando's ability to generate favorable experiences through interaction with its visual elements and sequence of activities.

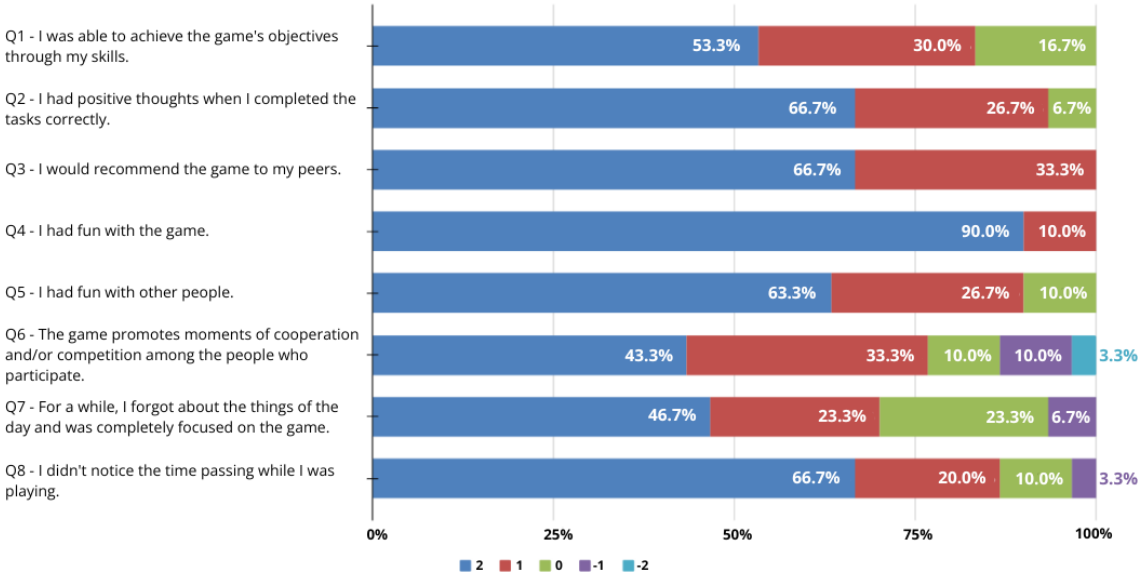

Figure 4. Results of the User Experience Dimension

From the responses shown in Figure 4, there is a predominantly positive perception regarding the game and its ability to provide fun, immersion, and a sense of competence to users. It is observed that responses with ratings of +2 and +1 are more predominant in questions Q1, with 83.3% of participants agreeing, Q2, with 93.4% agreeing, Q3 and Q4, with 100% agreeing, Q5, with 90% agreeing, and Q8, with 86.7% agreeing. On the other hand, questions Q6 and Q7 received +2 and +1 ratings in a lower proportion, with 76.6% agreeing with Q6 and 70% agreeing with Q7. The decrease in these ratings for Q6 can be justified by the lack of use of the ranking tool observed during testing due to the difficulty of reconciling it with the shared use of devices. As for Q7, this decrease may be due to the lack of animation and music in the game, aspects that were requested by students in their descriptive feedback.

4.3. Learning

In the learning dimension, only the perceptions of the 26 students are presented, disregarding the responses provided by teachers and interns, to exclusively evaluate the effective teaching capacity of the application for the target audience. This dimension is divided into two types of approaches.

The first approach mentioned and added in the model by Savi et al. (2011), analyzes the students' perception regarding short-term and long-term learning variables [Moody e Sindre 2003]. For each variable, a question was provided with answers varying on the Likert scale, following the same process as the previous subsections, as illustrated in Figure 5.

From the analysis of the responses provided, it is possible to see that 96.2% of the students questioned believe that the game will contribute to their curricular activities on the subject (Q1 - Long-Term Learning). Furthermore, 100% of the participants believe that Substantivando contributed to their learning about nouns (Q2 - Short-Term Learning). These results highlight once again the students' satisfaction with the game and its usefulness in the learning process.

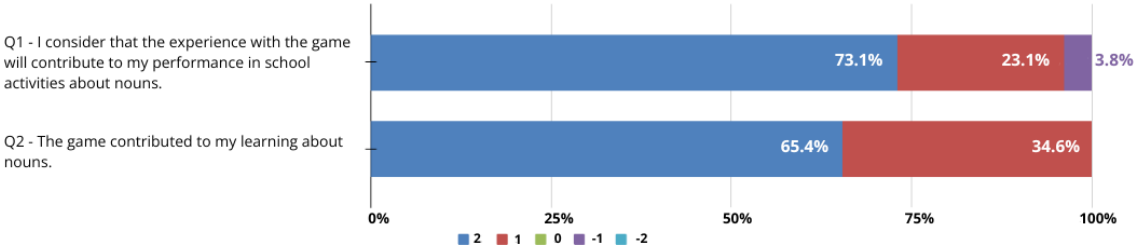

Figure 5. Results of the Learning Dimension

The second approach, adapted and mentioned in both works of Savi et al. (2010) and Savi et al. (2011), was implemented to evaluate not only the students' perception of the game but also its real impact on learning. Thus, users were asked questions about their understanding of the classifications and inflections of nouns before and after playing. The responses varied on a scale of 1 to 5, where 1 represented "very little" knowledge and 5 represented very good knowledge.

In Table 1, Item 1 deals with the understanding of noun classifications, while Item 2 addresses the understanding of noun inflections. It is noted that in both Items, there was a significant percentage increase in the averages before and after using the application. This shows the real impact generated by Substantivando in teaching the grammatical class of nouns and promoting visible learning for the students.

Table 1. Self-Assessment Average

Items	Before Using the Game (Average)	After Using the Game (Average)	Percentage Increase (%)
Item 1	2,19	3,81	73,97
Item 2	2,19	3,88	77,16

4.4. Descriptive Questions

Finally, this section is about the students' opinions and suggestions, where various positive responses regarding the game's design and gameplay were collected. In response

to the question “What did you like about the game?”, there were answers such as “Simple and easy to understand”, “easy to use and fun”, “The explanation of the subject before the question”, and “It’s cool, I loved the game, it’s colorful and perfect”, along with positive comments about the questions and themes. Additionally, when asked how the game could improve, users had responses such as “More questions per stage”, “More diverse questions”, and “It could have more colors and activities”, as well as several suggestions for adding background music and animations, which will be considered in future improvements to the game.

5. Conclusion

This study presents Substantivando, a gamified educational game designed to provide an engaging learning experience for elementary school students. The application features functionalities such as explanations, quizzes, scoring, and a ranking system, intending to teach the grammatical class of nouns, their classifications, and inflections playfully.

Based on the analysis of the tests, satisfactory results were obtained that prove the efficiency of the software in meeting the objectives outlined in the introduction (see section 1). Objective **(a)** was achieved, as demonstrated by the responses to question Q2 in Figure 5 and by the significant percentage increase in learning shown in Table 1 after using the application, demonstrating the real impact of the game on learning. Objective **(b)** was attained, as shown by the responses in Figure 3 and the result obtained in question Q1 in Figure 5, highlighting the game’s ability to motivate users and support the educational process. Finally, objective **(c)** was achieved, according to the results in Figure 4, indicating that the game is capable of providing good experiences such as fun, entertainment, and immersion. In addition to achieving the mentioned objectives, the results also show that Substantivando is a quality game, as evaluated by the dimensions proposed by the models of Savi et al. (2010) and Savi et al. (2011).

However, even though the work has presented satisfactory results, it is worth considering its limitations. Among them, it is possible to highlight the lack of elements that make the game experience accessible to students who have specificities that would hinder or prevent its use, such as the absence of audio features that enhance understanding for students with low literacy or visual impairments, the limited adaptation of the game for students with Attention Deficit Hyperactivity Disorder (ADHD) or dyslexia, the lack of translation of the game into Sign Language (Libras), among others. Additionally, the game’s unavailability on platforms like the *Google Play* Store hampers its promotion and, consequently, its accessibility to the target audience.

For future works, the authors aim to use the responses obtained in the tests to enhance the application, taking measures such as modifying factors that may have elicited negative responses. Furthermore, in future versions, it is planned to expand the number of questions, add a possible soundtrack and animations, implement audio guides, work on visual elements that help students with ADHD and dyslexia, and translate the game to Libras, ensuring that deaf students can benefit from Substantivando, making the game more inclusive for various audiences in Elementary School. Also planned is the availability of the game on the *Google Play Store* to increase awareness and accessibility to Substantivando.

References

Ajogbeje, O. J. (2023). Enhancing classroom learning outcomes: The power of immediate feedback strategy. *International Journal of Disabilities Sports and Health Sciences*, 6(3):453–465.

Amzalag, M., Kadusi, D., e Peretz, S. (2024). Enhancing academic achievement and engagement through digital game-based learning: An empirical study on middle school students. *Journal of Educational Computing Research*, page 07356331241236937.

Anastasiadis, T., Lampropoulos, G., e Siakas, K. (2018). Digital game-based learning and serious games in education. *International Journal of Advances in Scientific Research and Engineering*, 4(12):139–144.

Baltes, S. e Diehl, S. (2014). Sketches and diagrams in practice. In *Proceedings of the 22nd ACM SIGSOFT International Symposium on Foundations of Software Engineering*, pages 530–541.

Barbosa, S. D. J., Silva, B. d., Silveira, M. S., Gasparini, I., Darin, T., e Barbosa, G. D. J. (2021). Interação humano-computador e experiência do usuario. *Auto publicação*.

Barz, N., Benick, M., Dörrenbächer-Ulrich, L., e Perels, F. (2024). The effect of digital game-based learning interventions on cognitive, metacognitive, and affective-motivational learning outcomes in school: A meta-analysis. *Review of Educational Research*, 94(2):193–227.

Calvillo Gámez, E. H. (2009). *On the core elements of the experience of playing video games*. PhD thesis, UCL (University College London).

Costa, D. L., Abrantes, D., Albert, F., e Bacelar, M. (2018). Revisão bibliográfica dos aspectos e métodos componentes da gamificação na educação. *Feedback*, 10(1):6.

da Silva, J. B., de Oliveira Silva, D., e Sales, G. L. (2018). Modelo de ensino híbrido: a percepção dos alunos em relação à metodologia progressista x metodologia tradicional. *Revista Conhecimento Online*, 2:102–118.

da Silva Neto, J. S., dos Santos, B. D. R., de Sousa, B. F., Bittencourt, I. I., e Challco, G. C. (2023). Revisão sistemática da literatura sobre gamificação, satisfação e diversão na educação. *Revista Brasileira de Informática na Educação*, 31:887–905.

de Almeida Brochado, R. e de Carvalho, M. A. G. (2021). Revisão sistemática de estudos e aplicações de modelos pedagógicos diversificados. *Revista Brasileira de Informática na Educação*, 29:718–745.

Deterding, S., Dixon, D., Khaled, R., e Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. volume 11, pages 9–15.

Dichev, C. e Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *International journal of educational technology in higher education*, 14:1–36.

Ferreira da Cunha, C. e Lindley Cintra, L. (2013). Nova gramática do português contemporâneo.

Francisconi, L. R. A. (2020). Léxico e enunciação: a conceitualização do substantivo concreto. questões para o ensino de línguas.

Fu, M. e Li, S. (2022). The effects of immediate and delayed corrective feedback on l2 development. *Studies in Second Language Acquisition*, 44(1):2–34.

Graciano, M. D., de Aguiar, F., das Neves Santos, L., Filho, E. C., e Dainesi, F. G. (2018). Jogo educacional para matéria de língua portuguesa: Caça aos coletivos. *Proceedings of SBGames*, pages 1–4.

Hanus, M. D. e Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers Education*, 80:152–161.

Jonassen, D. (2000). Toward a design theory of problem solving. *Educational Technology Research and Development*, 48(4):63–85.

Keller, J. M. (1987). Development and use of the arcs model of instructional design. *Journal of instructional development*, 10(3):2–10.

Laine, T. H. e Lindberg, R. S. N. (2020). Designing engaging games for education: A systematic literature review on game motivators and design principles. *IEEE Transactions on Learning Technologies*, 13(4):804–821.

Lampropoulos, G. et al. (2024). Virtual reality and gamification in education: a systematic review. *Educational technology research and development*, pages 1–95.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of psychology*.

Mellos, D. M. (2014). Jogo educativo digital para fixação do aprendizado da gramática. B.S. thesis, Universidade Tecnológica Federal do Paraná.

Miranda, M., Nascimento, M. N., de Oliveira, G., Pereira, J., e Ishitani, L. (2023). Avaliaçao de conhecimento em jogos sérios: Uma revisao sistemática de literatura. *Anais Estendidos do XXII Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 513–525.

Moody, D. L. e Sindre, G. (2003). Evaluating the effectiveness of learning interventions: an information systems case study.

Morais, A. A. e Melo, L. B. (2021). Gamificação personalizada: um estudo de mapeamento sistemático. In *Anais do XXXII Simpósio Brasileiro de Informática na Educação*, pages 392–405. SBC.

Paiva, C. A. e Tori, R. (2017). Jogos digitais no ensino: processos cognitivos, benefícios e desafios. *XVI Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 1–4.

Ramos, A. A. B., de Souza, N. D. M., e Corrêa, A. G. D. (2014). Desenvolvimento de um jogo digital interativo para apoiar a aprendizagem de libras e da língua portuguesa. *Revista Trilha Digital*, 2(1).

Savi, R., Von Wangenheim, C. G., Ulbricht, V., e Vanzin, T. (2010). Proposta de um modelo de avaliação de jogos educacionais. *Revista Novas Tecnologias na Educação*, 8(3).

Savi, R., Wangenheim, C., e Borgatto, A. (2011). Um modelo de avaliação de jogos educacionais na engenharia de software. *Anais do XXV Simpósio Brasileiro de Engenharia de Software (SBES 2011), São Paulo*.

Schünemann, L. H. A. e Garcia, T. R. (2023). Aplicabilidade de jogos digitais comerciais na educaçao: Uma revisao da literatura. *Anais do XXXIV Simpósio Brasileiro de Informática na Educação*, pages 752–763.

Silva, C. (2022). Léxico e enunciação: contribuições para o ensino do substantivo. *Estudos Linguísticos (São Paulo. 1978)*, 51(3):1336–1352.

Tyni, J., Turunen, A., Kahila, J., Bednarik, R., e Tedre, M. (2023). Reward types in popular recreational and educational mobile games. *IEEE Access*, 11:1166–1174.

Uzeda, L. E., Parreiras, M., e Xexéo, G. (2023). Exploring the intersection of game-based learning and sustainable education in engineering: A bibliometric analysis. In *Anais Estendidos do XXII Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 683–694. SBC.

Victal, E., Junior, H., Rios, P. T. G., e de Menezes, C. (2015). Aprendendo sobre o uso de jogos digitais na educação. In *Anais do Workshop de Informática na Escola*, volume 21, pages 444–453.

Yang, Y.-F., Lee, I.-C., Tseng, C. C., e Lai, S.-C. (2024). Developing students' self-regulated learning strategies to facilitate vocabulary development in a digital game-based learning environment. *Journal of Research on Technology in Education*, pages 1–20.

Zhou, S. e Bakhir, N. M. (2024). Interdisciplinary art learning through artistic digital game-based learning (dgbl): Evaluating learning outcomes and processes among science and engineering students. *Empirical Studies of the Arts*, page 02762374241246948.