Research, Society and Development, v. 11, n. 12, e455111234499, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i12.34499

Digital games as tools for corporate work and movement in the learning process

Jogos digitais como ferramentas para o trabalho da corporeidade e movimento no processo de aprendizagem

Los juegos digitales como herramientas de trabajo y movimiento corporativo en el proceso de aprendizaje

Received: 08/23/2022 | Reviewed: 09/09/2022 | Accept: 09/13/2022 | Published: 09/20/2022

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Abstract
Movement must be part of the school experience, becoming a constructive part of learning. This training process is not only linked to cognitive learning, but also to the learning of meaning and the body. Aiming to link interdisciplinarity to movement, with a view to breaking this dualistic barrier, we seek to validate games capable of perceiving the child's movements in order to generate a real-time interaction with digital dynamics that stimulate the same. In this sense, this article seeks to develop game prototypes using Scratch to assist children in learning, involving physical interaction. From this perspective, there is the insertion of the child in a playful digital environment with activities that develop the expected skills, where the movements interact with them. To support this discussion, the present work has as its theoretical foundation the Learning Based on Digital Games combined with physical exercises, the exerlearnings. The exerlearnings for this work bring the possibility of integration of movement in the area of languages, ceasing to be an exclusive factor for the discipline of Physical Education. It is expected that the artifact will contribute positively to the education of children, making the concepts of the area of languages work and experience.
Keywords: Learning Based on Digital Games; Movement; Exerlearnings.

Resumo
O movimento deve fazer parte da vivência na escola, transformando-se numa parte construtiva da aprendizagem. Esse processo de formação não está atrelado apenas a aprendizagem cognitiva, mas também a do sentido e a do corpo. Visando atrelar a interdisciplinaridade ao movimentar-se, com vistas a quebrar essa barreira dualística, busca-se validar jogos capazes de perceber os movimentos da criança a fim de gerar uma interação em tempo real com dinâmicas digitais que estimulem o mesmo. Nesse sentido, este artigo busca desenvolver protótipos de jogos utilizando o *Scratch* para auxiliar crianças na aprendizagem, envolvendo a interação física. Nessa perspectiva, há a inserção da criança em um ambiente digital lúdico com atividades que desenvolvam as habilidades esperadas, onde os movimentos interagem com a mesma. Para embasar esta discussão, o presente trabalho tem como fundamentação teórica a Aprendizagem Baseada em Jogos Digitais combinada com exercícios físicos, os *exerlearnings*. Os *exerlearnings* para este trabalho traz a possibilidade de integração do movimento na área de linguagens, deixando de ser fator exclusivo para a disciplina de Educação Física. Espera-se que o artefato contribua de forma positiva na educação das crianças, fazendo com que os conceitos da área de linguagens sejam trabalhados e vivenciados.
Palavras-chave: Aprendizagem Baseada em Jogos Digitais, Movimento corporal, *Exerlearnings*.

Resumen
El movimiento debe ser parte de la experiencia escolar, convirtiéndose en una parte constructiva del aprendizaje. Este proceso formativo no sólo está ligado al aprendizaje cognitivo, sino también al aprendizaje del significado y del cuerpo. Con el objetivo de vincular la interdisciplinariedad al movimiento, con miras a romper esta barrera dualista, buscamos validar juegos capaces de percibir los movimientos del niño para generar una interacción en tiempo real con dinámicas

digitales que estimulen el mismo. En este sentido, este artículo buscam desarrollar prototipos de juegos utilizando Scratch para asistir a los niños en el aprendizaje, involucrando la interacción física. Desde esta perspectiva, se encuentra la inserción del niño en un entorno digital lúdico con actividades que desarrollan las habilidades esperadas, donde los movimientos interactúan con ellas. Para sustentar esta discusión, el presente trabajo tiene como fundamento teórico el Aprendizaje Basado en Juegos Digitales combinado con ejercicios físicos, los exerlearnings. Los exerlearnings para este trabajo traen la posibilidad de integración del movimiento en el área de lenguajes, dejando de ser un factor exclusivo para la disciplina de Educación Física. Se espera que el artefacto contribuya positivamente a la educación de los niños, haciendo trabajar y vivenciar los conceptos del área de idiomas.
Palabras clave: Aprendizaje Basado en Juegos Digitales; Movimiento Corporal; Exerlearnings.

1. Introduction

The present work presents the investigation and development of games using Scratch as a tool to help the learning of basic education students, in the final years of elementary school. Nowadays, there is a focus on games and games in education, thanks to research that proves the importance of these activities in child development. Vygotsky (1984), a Russian psychologist, points out that communication is a fundamental factor in children's lives, both for thinking and for interaction and communication.

For Kishimoto (2002, p. 146), “because it is an action initiated and maintained by the child, play enables the search for means, through exploration, even if disordered, and plays a fundamental role in the construction of know-how”.

Considering the importance of moving for children, this action must be part of the experience at school, becoming a constructive part of learning, as stated by Hildebrandt-Stramann (1999). Also, according to the author, this training process is not only linked to cognitive learning, but also to the learning of meaning and the body.

In addition, movements contribute to children's quality of life, since one of the factors for childhood obesity is the lack of physical exercise, which can cause other health problems, such as asthma (Wang, 2020; Zabala, 2015).

There is also research in recent years that confirms that learning using movements and gestures, rather than restricting them, promotes more effective learning for students (Cook, 2008). A minimum of physical exercises can contribute to their learning, because when they actively participate in such a process, they memorize the teachings better than when received passively (Lucht, 2010; Melo, 2022).

Antunes (2003) says that the word game moves away from the meaning of competition and approaches its Latin etymological origin, in the sense of fun, play, pastime. Still, it complements that essentially aims to stimulate learning, with interpersonal relationships within certain rules. According to Lopes (2002), the game for the child is the exercise, it is the preparation for the adult life, because the child learns by playing, it is the exercise that develops the potentialities.

Digital games correspond to one of the main ways for children to enter the world of technology (Gros, 2003), as they are motivating and fun. That's why it's smart to appropriate this tool for pedagogical use, stimulating children's skills and competences while they play.

Working with children in this perspective of movement, games and play, is still something innovative in most environments in elementary school. In the final years of elementary school, the movement is worked on in the discipline of Physical Education and in some practices during the school year.

From this, a concern emerges about the possibilities of intervention in this sense in elementary school, especially in the 6th year, which is part of the final years of Fundamental Education I, in which the question is: is it possible to integrate body movement through educational digital games and playful in the area of languages in elementary school? In response to this problem, this study proposes to develop prototypes of educational games using movement to validate the integration and playfulness of games.

Background

Exergames vs Exer-learning

In computing, there is the Human-Computer Interaction (HCI) area, through which a new class of games was developed, the Exergames or Exertion Games (Vaghetti & Botelho, 2010). Exergame emerged in the mid-1990s, specifically in 1998, with Konami's Dance Revolution. It arises with the aim of helping to control obesity, especially in children, and has become a major source of profit for the Konami company (Sinclair, 2007). In 2006 comes the Nintendo console, the Wii, with various types of games following the same model.

Exergames combine physical exercise with games, using playfulness and the fascination of digital games cooperating to practice physical activity (Lam, 2011). So Exergames are nothing more than a different form of HCI with games, where the objective is to use the body for this interaction – that is, to move to play. The main objective is to use exercises, the movement, to play. Papastergiou (2009) comments that the possibility of using body movement as an integral part of the game establishes a favorable environment for the teaching-learning process as a true didactic-pedagogical tool, and becomes an object of investigation by the scientific community.

Exer-learning organically combines learning activities, physical exercise and digital games, seeking to value physical exercise and learning, where both can be achieved in a balanced way. It is important to note that Exer-learning differs from kinesthetic learning, where exercise is just a tool for learning, but the focus is on learning, although both involve exercises and learning (Wang, 2020).

2. Methodology

The methodology chosen for this study was Design Science Research (DSR). According to Pimentel (2020), DSR is used when the researcher has two objectives in his research: solving a practical problem in a specific environment through an artifact; and generate new scientific knowledge.

In this sense, artifact is understood, according to Peffers (2007), any initiative designed to achieve a goal. Table 1 below shows the main types of technological artifacts for solving problems in the computing area.

Table 1 - Types in artifacts.

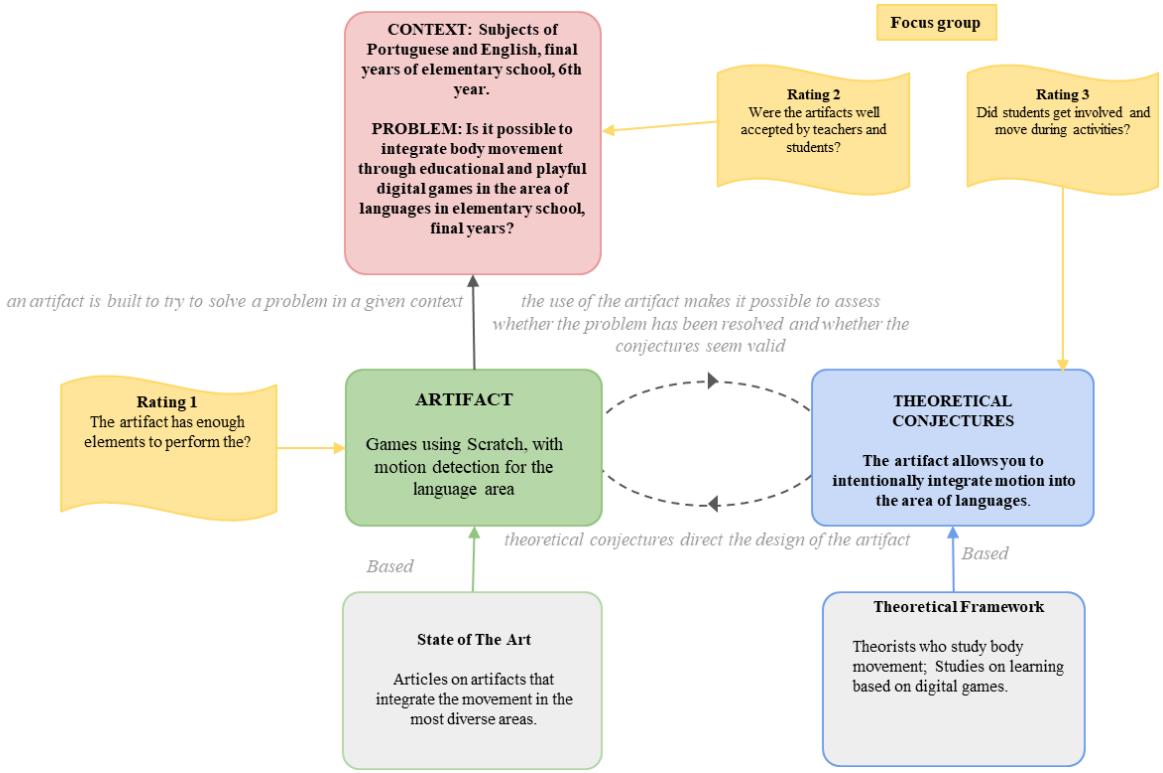
TYPE IN ARTIFACT	DESCRIPTION
Construct	Vocabulary conceptual in a domain
Model	propositions what express relationships in between you constructs
framework	Guide, conceptual or real, what it suits as Support or guide
Architecture	systems in structure in high level
Principle in project	key principles and concepts for guide O project
Method	steps for run tasks – "as to do"
instantiation	Implementations in environments that operationalize constructs,models, methods and others artifacts abstract
theories in project	Set prescriptive in instructions about as to do something for catch up certain objective. A theory often includes other artifacts abstracts, such as constructs, models, frameworks, architectures, Principles of design and methods.

Source: Pepper, Filippo and Santoro (2020).

Design Science deals with the part called to design the artifact for a proper context that solves a real problem, while the

Science of Knowledge has about you assumption related to behavior human and organizational structure. In this context, the theoretical assumptions support the design of the artifact and the use of the artifact makes it possible to investigate the theoretical assumptions. Figure 1 makes it possible to understand in summary what will be discussed in this article (Hevner, 2007).

Figure 1 - Research synthesis map.



Source: Authors.

The work is characterized as an exploratory, descriptive case study with a combined approach (quantitative and qualitative). Data, information and definition of methods were performed based on the consensus of the study or that none of the authors' data consists of the application of the Delphi method (Gil, 2002; Ludke & André, 2013).

3. Results and Discussion

Scratch was used to develop the artifacts. It is a freely distributed programming platform developed by the Lifelong Kindergarten research group at the Massachusetts Institute of Technology (MIT) Media Laboratory . Through programming in its plug-in blocks, Scratch becomes very intuitive, allowing children from the age of 8 to use it, creating their own stories, games and interactive animations.

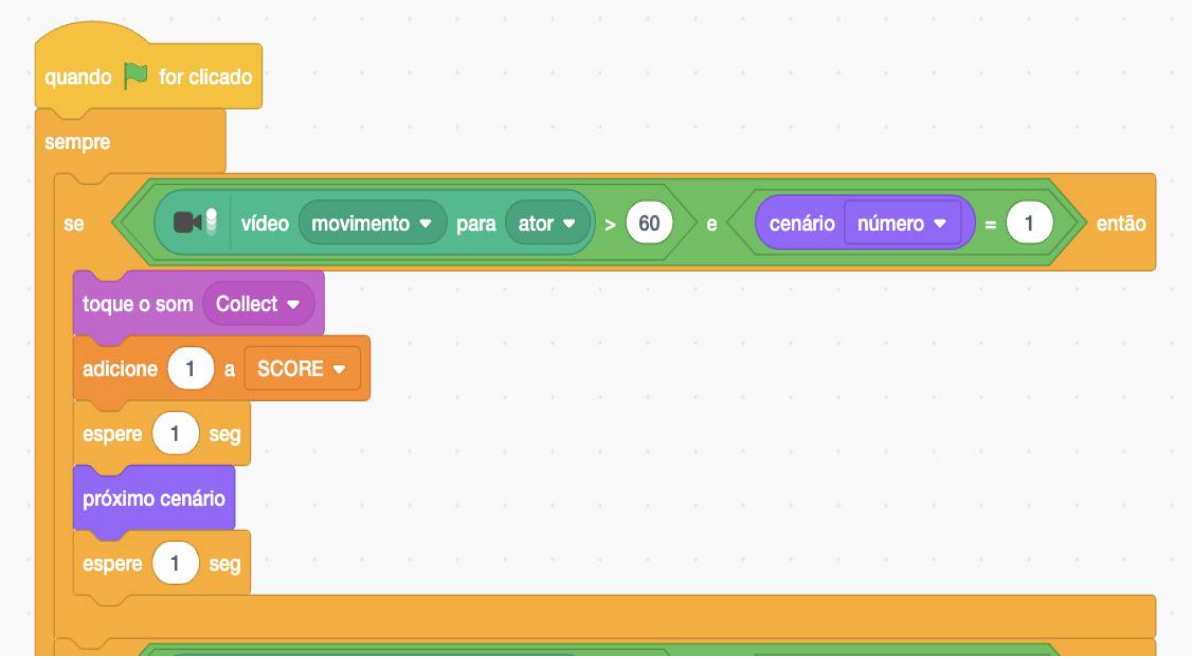
As it is a block programming platform, the code becomes playful and allows you to make changes with assertiveness seeking improvements to the project. Block programming is nothing more than a guise for the lines of code, transforming the visual environment into a much friendlier structure. These blocks replace traditional lines of code.

Within the platform, there is access to an extension that makes it possible to use the computers' WebCam to detect movement. All the artifact produced in this environment is based on this functionality, capturing the movement of children. Two games were built, in the quiz model: question and answer games, in which children would have to move to the correct answer, in order to answer the research problem.

To implement these games, it was necessary to create lesson plans, methodology and well-defined objectives, both for English and Portuguese subjects. The lesson plans were based on the BNCC (National Curricular Base), seeking to mobilize some specific skills. It is important to emphasize that, in addition to the specific skills of the subjects worked, Physical Education skills were also necessary.

The first one was a game about the Morphosyntax knowledge object, in which when moving to the right answer, the game would identify if it was correct, and score a point if yes and, if not, the point is not scored. The game has a timer that limits the players' time, in order to make the game more dynamic. Figure 2 shows how the programming in blocks is organized and the basic structure set up for the game. This code snippet repeats with each new question.

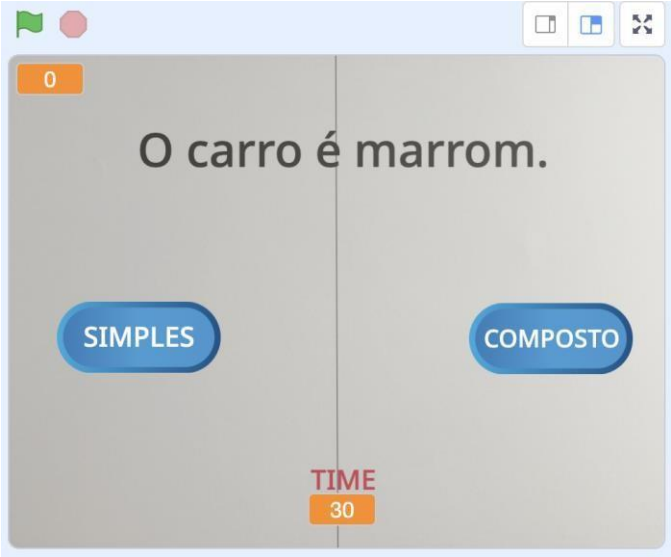
Figure 2 - Code snippet of the programming in blocks used in the artifact.



Source: Authors (2022).

Figure 3 shows the game screen in operation, with the buttons that the child moves to "press".

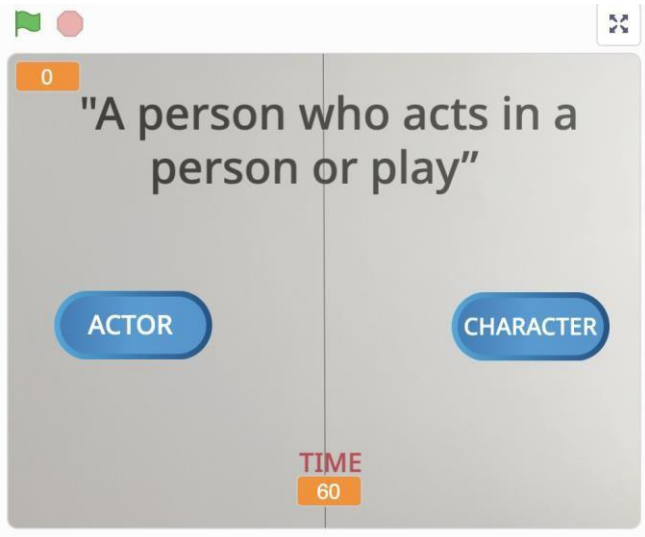
Figure 3 – Home screen of the Portuguese game.



Source: Authors (2022).

The other artifact built brings the same idea as the previous one, a quiz, but now for the English discipline. Here, students are exposed to an English phrase with clues to a keyword, a keyword, in which they have to move to the word correct from the interpretation of the sentence. In this artifact, the aim is to acquire vocabulary and interpret the text. Figure 4 shows the main screen of the game in operation.

Figure 4 - English game home screen.



Source: Authors (2022).

These were the two artifacts built for the tests, in addition to the aforementioned lesson plans with the methodology for their application. As a demonstration of the artifact as a solution, it was applied in a private school in the city of Natal-RN, with students from the 6th year of Basic Education. The age of participating students is between 11 and 12 years old. These students have a history of accessibility to technologies.

Maker Space , which has chromebooks , notebooks , laser cutter , 3D printer, webcams , tools, robotics kits, among other devices. The devices used for the application were chromebooks and notebooks that have an integrated webcam , and external webcams are not used to recognize student movements. Figure 5 illustrates this space.

Figure 5 - Maker Space where the classes took place.

Source: Authors (2022).

The tables were changed and a more suitable space for the game was set up, where students could move around more freely. Two lesson plans were built for the demonstration with a more detailed didactic sequence. After welcoming the students, a brief explanation of how the game works and the subject the game was about, the students went to play Exer-learning . Figures 6-7 illustrate records of the time when students played.

Figure 6 – Photo of students interacting with the games.

Source: Authors (2022).

Figure 7 – Photo of students interacting with the game.

Source: Authors (2022).

As artifacts for this study we have the two games created for the area of languages, and two lesson plans for their use. Subsequently, a website was created, on the Google Sites platform , entitled Move Scratch to make the lesson plans and games available. Figure 8 represents the initial screen of the website where the artifacts were developed.

Figure 8 – Home screen of the website with the exhibition of artifacts.

Source: Authors (2022).

In order to validate what was developed, two evaluations were carried out: the first considering the requirements of the researchers involved, seeking to reach the minimum criteria for the implementation of the game in the classroom; and the second through the tests themselves, through the lesson plans created for the artifacts. We sought to answer questions of a

technical nature, usability of games, interface, gameplay and level of movement for interaction with the game, as shown in Table 2:

Table 2 - Researcher's own evaluation criteria.

CRITERIA	NEVER	OFTEN	EVER
The game is visually friendly		x	
The game brings game elements			x
WebCam can detect motion		x	
To interact with the game the player moves from their current resting place			x
The response of hits and misses is fast			x

Source: Authors (2022).

These criteria were revisited throughout the artifact creation process, made and redone until the games were suitable for the classroom. Only then did it proceed to the second evaluation.For this research, an online Focus Group (FG) was carried out with the teachers of the subjects participating in the project, which were Portuguese and English. Through the FG, some questions were asked to direct the qualitative data to be obtained for the research.

The FG can be considered a group interview.Different from an interview in which specific questions are asked, and follows the answers of the interviewees, what happens is an interaction between the members guided by a mediator, and more open questions can be asked in the mediation and not “closed” questions.

The FG's script for this research was in the exploratory sense to answer the research question - whether it is possible to integrate movement using educational digital games in the area of languages. The members of the group were the teachers who participated in the demonstration of the artifacts. The questions for discussion were:1) Is it possible to integrate body movement using digital games, exer-learnings ; 2) Its use is feasible to fit into the pedagogical planning; 3) There were impacts of the action. It is from these points that the result of this research is directed.

The first point observed is that the integration of exer-learnings was possible , since the students were able to experience this new way of interacting with the game. One of the professors comments: “I felt engagement and that the execution was easy, but that the students needed some time to understand how to use it”. Another teacher says: “The students got involved, participated effectively, formed groups, competed, helped each other and it was fun. I found the application very easy, even though I am not very skilled with technologies”. In this sense, we noticed that the application was satisfactory in terms of student involvement and the application of lesson plans with the game.

Another interesting point cataloged in this FG with the teachers was the interest in carrying out the activities at other times, including the use of exer-learning in other subjects of the discipline.They also pointed out possible improvements to the project and possible new forms of interaction. A teacher commented: “I don't know if it's possible, but I think it might be used in an activity to 'link' one item to another? That is, is it possible to put items in order? If these functionalities are possible to implement, the range of activities to be created greatly increases”. It is noteworthy that a common point mentioned by the teachers was the improvement of motion capture. Some relevant considerations were expressed by this FG:

a) The movement of the students was notorious; to interact, they did not stand still during the activity, and moved freely, choosing how to get from one side to the other;

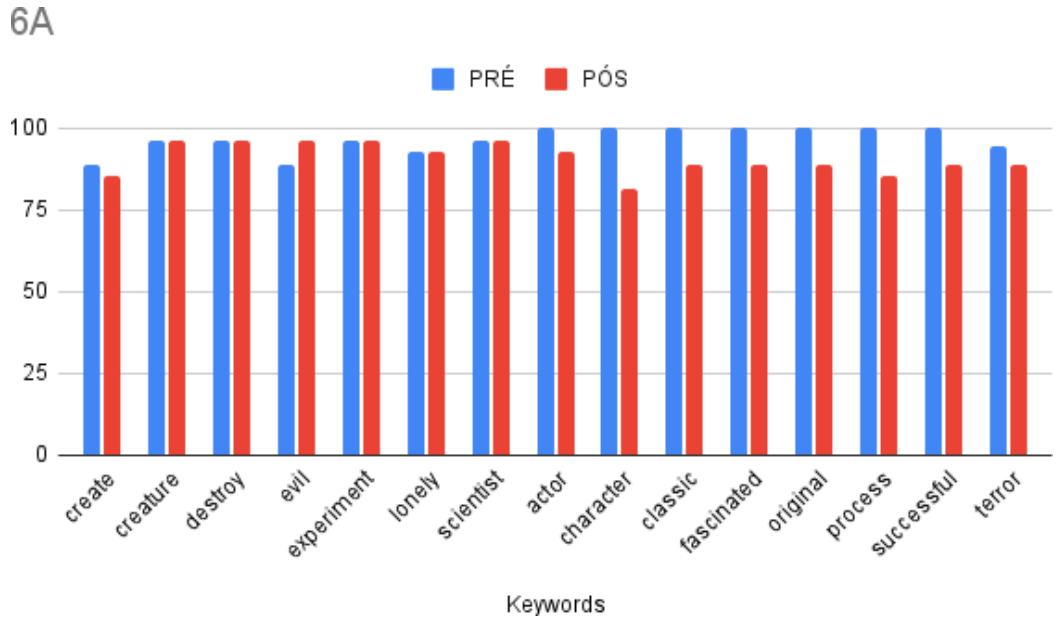
b) It was observed that the students were involved with the activity, they were engaged;

c) It is possible this integration in the area of languages, being able to even approach other subjects of the respective disciplines sampled.

In addition, it was found interesting to try to somehow measure the impact of one of the artifacts for its proposal - in this case, the English discipline, which had a pre-test for comparison . to one month from the application of the game, and another to 15 days. The data deals with the percentage of hits of the whole class for each keyword, which we can also call the ease index.

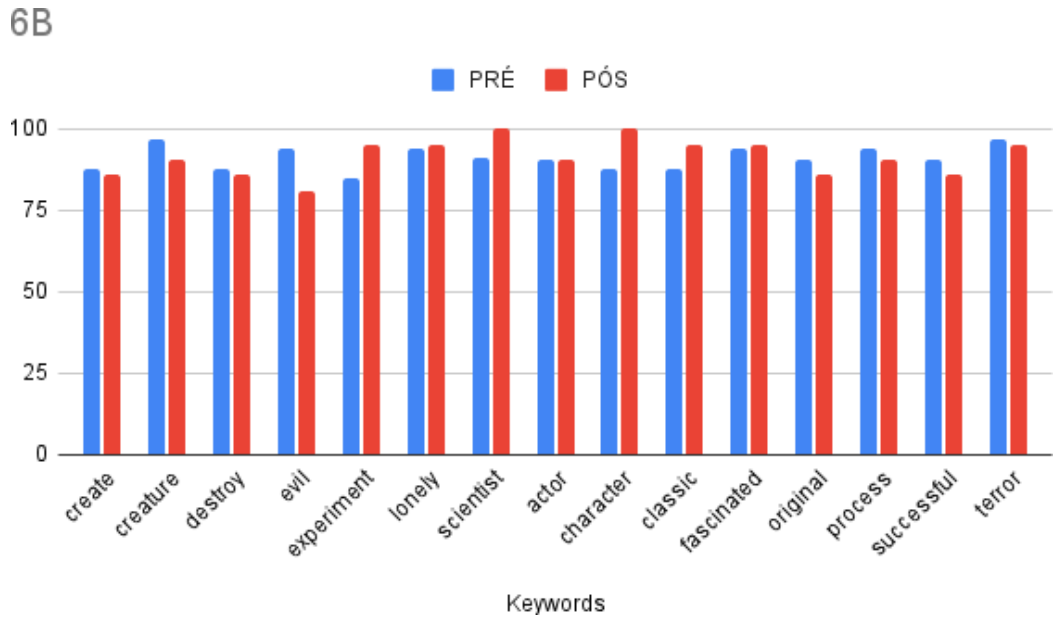
After the application of the game in the English course, the questionnaire was passed again, but now with all the keywords used in the educational game. Some graphs of this data obtained from the classes: 6A, 6B, 6C and 6D are shown in Figures 9-12.

Figure 9 – Graph in pre comparison and posttest 6A.



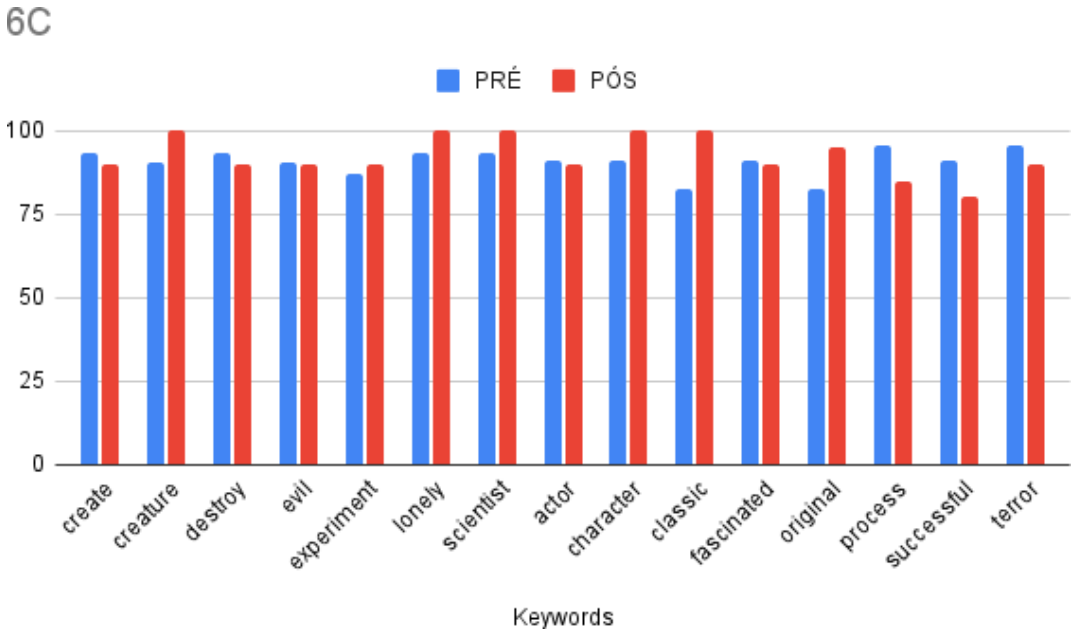
Source: Authors (2022).

Figure 10 - Pre and post test comparison chart 6B.



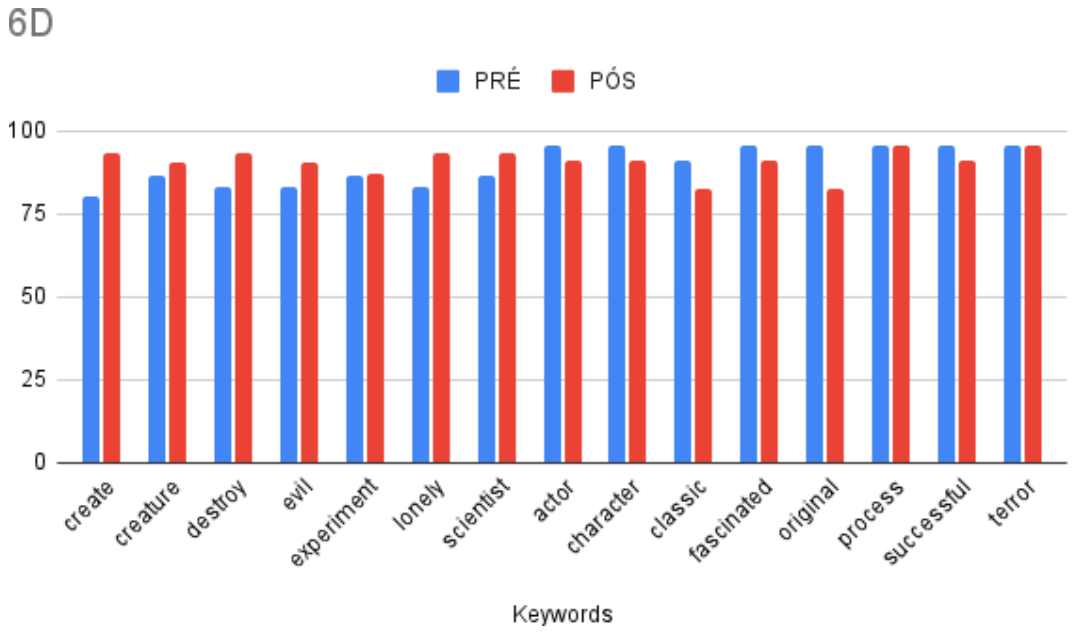
Source: Authors (2022).

Figure 11 - Pre and post 6C test comparison chart.



Source: Authors (2022).

Figure 12 - 6D pre and post test comparison chart.



Source: Authors (2022).

Analyzing the graphs, it can be seen that the class that performed better in the post-activity test was class "C", which by the way was the most concentrated and participatory class in the activity.Point to be mentioned is that, in general, the students maintained an interesting hit rate, even with a drop in performance.

4. Conclusions

The research carried out confirms that it is possible to integrate body movement in the area of languages through exer-learning. There were satisfactory results in terms of use and it is noteworthy that there were no significant difficulties in its implementation. The students got involved in the activity, having fun while using their bodies to interact.

The production of games using movements as proposed by the work managed to meet expectations. The tests showed that the games were able to meet the objective of bringing movement to the classroom, in the area of languages.

It is also possible to measure the impacts on student learning, as the data showed a good result in the post-test. For the English discipline game, the students maintained a high level of correct answers in the questions, even after some time had elapsed from the content presented in the classroom. It should be taken into account that the class which participated more actively in the activity had better results.

For further research, it is interesting to increase the sampling of new interaction models, in addition to the suggested quiz. Another point is the improvement of the platform for capturing movements and prototyping games, taking into account that Scratch has its limitations.

The next steps are the development of a physical artifact that serves as a control for the games. This point was brought up by the teachers in the Focus Group, when they mentioned that it would be interesting to improve the capture of movements, being able to use more robust equipment, such as Microsoft 's Kinect , as well as cameras equipped with sensors.

Another point to be worked on is the multiplayer feature, which would promote group activities or even for the entire room to interact with the games. This feature brings greater interactivity to the game.

This research opens up the possibility of future studies, as it deals with a field that is already explored in the games, rehabilitation, and health improvement industry, although it is evident that there is a lack of pedagogical approach to learning games using body movement.

In addition, it is relevant to consider the segregation in the literature of the body of the mind in current curricula, according to the gap evidenced in the theoretical contribution of this study. Le Boulch (1988) himself points out, it is not something exclusive to early childhood education. These types of games, the exer-learnings , can be considered facilitators for this integration, and these moments of movement are not something exclusive to Physical Education and recess at school.

Acknowledgments

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