PROGRAMA DE PÓS-GRADUAÇÃO EM EDUCAÇÃO
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Jogos e elementos da gamificação como estratégias pedagógicas para o ensino de Ciências na Educação do Campo

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Resumo
Este artigo relata uma pesquisa que teve como objetivo geral analisar as contribuições de uma sequência didática, elaborada a partir de estratégias investigativas de jogos educativos e elementos da gamificação, no processo de ensino e aprendizagem do conteúdo *Adolescência e Reprodução Humana*. Para o desenvolvimento deste estudo, realizamos uma pesquisa exploratória, de natureza qualitativa, que foi desenvolvida por meio de um estudo de caso em uma turma do 8º ano do Ensino Fundamental, de uma escola do campo do município de Feira de Santana-BA. Para a coleta dos dados, elaboramos e aplicamos uma Sequência Didática para o ensino do conteúdo *Adolescência e Reprodução Humana* e um diário de bordo para registros e reflexões no decorrer da intervenção. Os resultados evidenciam que, por meio da SD, os estudantes construíram paulatinamente seu conhecimento, de forma prazerosa, a partir dos jogos e dos elementos de gamificação presentes, participando e expondo respostas que contribuíram para a aprendizagem do conteúdo da intervenção.

Palavras-chave: Educação do Campo. Gamificação. Ludicidade.

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Games and Gamification Elements as Pedagogical Strategies for Science Teaching in Rural Education

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Abstract
This article reports research whose general objective was to analyze the contributions of a didactic sequence, elaborated from investigative strategies of educational games and gamification elements, in the teaching and learning process of the *Adolescence and Human Reproduction* content. For the development of this study, we carried out exploratory research, of a qualitative nature, which was developed through a case study in a class of the 8th year of Elementary School, of a rural school in the city of Feira de Santana-BA. For data collection, we developed and applied a Didactic Sequence for teaching the *Adolescence and Human Reproduction* content and a logbook for records and reflections during the intervention. The results show that, through the DS, the students gradually built their knowledge, in a pleasant way, from the games and the gamification elements present, participating and exposing answers that contributed to the learning of the intervention content.

Keywords: Field Education. Gamification. Playfulness.

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Juegos y Elementos de Gamificación como Estrategias Pedagógicas para la Enseñanza de Ciencias en la Educación Rural

Cássia Chirlene Lima OLIVEIRA
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Resumen
Este artículo relata una investigación cuyo objetivo general fue analizar las contribuciones de una secuencia didáctica, elaborada a partir de estrategias investigativas de juegos educativos y elementos de gamificación, en el proceso de enseñanza y aprendizaje del contenido de *Adolescencia y Reproducción Humana*. Para el desarrollo de este estudio, se llevó a cabo una investigación exploratoria, de carácter cualitativo, que se desarrolló a través de un estudio de caso en una clase del 8º año de la Enseñanza Fundamental, de una escuela rural de la ciudad de Feira de Santana-BA. Para la recolección de datos, desarrollamos y aplicamos una Secuencia Didáctica para la enseñanza de los contenidos de *Adolescencia y Reproducción Humana* y un cuaderno de bordo para registros y reflexiones durante la intervención. Los resultados muestran que, a través de la SD, los estudiantes fueron construyendo su conocimiento, de forma agradable, a partir de los juegos y los elementos de gamificación presentes, participando y exponiendo respuestas que contribuyeron al aprendizaje de los contenidos de la intervención.

Palabras clave: Educación de Campo. Gamificación. Lúdico.

Introduction

According to Caldart (2012), the Campo Education modality was created to confront other capitalist education models and emerged from the desires of peasant social movements, and by its subjects men and women, workers of the field, including peasants, quilombolas, indigenous people, and wage workers with a labor link to the field.

As a recent modality, Campo Education in Science involves various reflections on teacher training that considers and articulates students' knowledge and experiences with scientific knowledge, so that learning is aligned with the realities of the field. Additionally, it requires a differentiated curriculum to address the specificities of these subjects. It is known that Science Education has faced several challenges, including making scientific advances and theories appealing to students. Therefore, to meet this demand, teachers need approaches that help in preparing the content to be worked on in the classroom, aiming for better student understanding.

According to Bizzo (2009), Science education provides a means to understand and interpret the world, contributing to the formation of future scientists. Scientific knowledge is acquired through observation and investigation. Thus, as a mediator and facilitator, the teacher must provide investigative activities that encourage students' curiosity, making lessons dynamic and interesting. Through Science Education, students build their knowledge, relate natural phenomena, their experiences, and the environment.

There is an urgent need for Science education to be based on possibilities that provide and offer access to students, so that they develop their abilities in observation, reflection, judgment, creation, cooperation, and action. This can be enhanced by employing playful and investigative strategies, such as gamification and the use of games, as these enable students to take a more active role in constructing scientific knowledge.

In this sense, games and gamification in Campo Science Education are didactic tools capable of balancing the playful and educational functions, and can be aligned with the student's reality.

According to Freire (2002), games, as directed activities, contribute to students learning to respect rules, broaden their relationships with others, express themselves, and solve problems more easily. There is a variety of pedagogical games that can aid in the development and construction of learning in various areas, enhancing students' attention and concentration, such as chess, board games, electronic games, and others.

Gamification involves using elements (features) of a game, but not necessarily games themselves, to motivate and facilitate learning. This strategy can bring several benefits to Science education because, through its elements, students acquire knowledge and skills necessary for abstracting reality, cooperation, curiosity, increased engagement, self-improvement, competition, intrinsic and extrinsic motivation[3], autonomy, and more.

In this context of possibilities for learning Science through playfulness, the research question guiding this work emerged: What are the contributions of a didactic sequence developed from investigative strategies of educational games and elements of gamification, in the teaching and learning process of the content *Adolescence and Human Reproduction*, in a Science class at a rural school?

The general objective of this research was to analyze the contributions of a didactic sequence, developed from investigative strategies of educational games and elements of gamification, in the teaching and learning process of the content Adolescence and Human Reproduction, in an 8th-grade Science class at a rural school in Feira de Santana-BA. Specific objectives included: developing and applying a didactic sequence for teaching the content Adolescence and Human Reproduction, based on investigative strategies; investigating the contributions of this didactic sequence to the teaching and learning process of the content Adolescence and Human Reproduction in the investigated class; and analyzing the contributions of the game and gamification elements as learning strategies for teaching Science in Rural Education.

This work is justified as playfulness and gamification can contribute to improving student engagement, which may enhance Science learning in the context of Rural Education. Additionally, despite a relatively large number of studies in the field of Science education, there is a need for more research using these pedagogical strategies in this context, to help teachers utilize them as active teaching and learning methodologies in Science.

Besides contributing to the literature, this research presents a significant contribution to Science teachers in basic education who work in rural schools. Our teaching practice has shown how important it is to deepen the understanding of the contributions these investigative strategies can bring to learning the covered content, as well as to help make Science teaching less traditional, enabling students to learn in a contextualized, playful, and enjoyable manner.

[3] Intrinsic motivation refers to engaging in activities where the pleasure is inherent to the activity itself, without needing external rewards (DECI, 1975). In contrast, extrinsic motivation involves performing a task in response to something external to the activity, such as obtaining material or social rewards (FORTIER; VALLERAND; GUAY, 1995).

Teaching Science in Rural Education

According to some authors, Science education has been characterized as uninteresting, decontextualized, and fragmented (MALDANER; ZANON, 2004; MEINAD, 2010), and requires a new curriculum and methodologies that move beyond traditional methods. According to the National Curriculum Parameters (PCN), "[...] the teaching and learning process in Natural Sciences can be developed within socially and culturally relevant contexts, which enhance meaningful learning" (BRASIL, 1998, p. 28). From this perspective, it is necessary for teaching to be linked to the students' knowledge and experiences, and for this, we should not separate school work from everyday life, as learning will occur from concrete experiences, and in this conception, the rural school extends beyond the school walls (SANTOS; JESUS; PORTO, 2020). Thus, Science teaching should value the community context, addressing its specificities and identity.

Furthermore, regarding Science education, among various objectives, students need to understand nature "as a dynamic whole, and humans, in society, as agents of transformation of the world they live in, in essential relation with other living beings and other components of the environment" (BRASIL, 1998, p. 33). In other words, Science education facilitates and contributes to the articulation between theory and practice, applying knowledge to transform and improve the living conditions of rural individuals.

Thus, it is clear that Science should be a part of Rural Education, whether through activities, explanations, etc., as it not only provides knowledge of personal experiences but can also be used for research, investigation, and more scientific proposals (DELIZOICOV; LORENZETTI, 2001), thereby enabling these students to be scientifically literate.

On the other hand, Lourenço (2013, p. 04) questions: "How to make science a democratic place of knowledge and participation, leading them to understand that there is harmony between scientific culture and everyday culture?" For the author, the success or failure in Science teaching relates to the student's ability to understand the elements that differentiate cultural, every day, and scientific worlds.

Moreira and Pinto (2003) emphasize that, for students to become interested and enhance their perception of scientific laws, it is essential that they relate methods or formulas to their prior knowledge and everyday life. To this end, the authors reveal the need to change pedagogical proposals in Science teaching.

This type of action aims at the result of a planning process related to the choice of content, procedures, activities, physical, human, and intellectual resources, strategies, assessment tools, methodology, and everything that promotes a better understanding of the subjects (SANTOS; PORTO, 2020), including investigative strategies such as playfulness, use of games, elements of gamification, experimentation, and problem-solving situations, among others. It is important to highlight that Science teaching in Rural Education should seek to overcome the difficulties students have in acquiring knowledge, aiming to develop new potentials and strengthen existing capacities (ARAÚJO; PORTO, 2019). It is known that environmental issues related to students' work routines in Rural Education can become pedagogical content, expanding learning methods and consequently contributing to students' continued interest in attending school.

Therefore, Science education in Rural Education must be connected to cultural, political, and social issues present in the community. Scientific knowledge needs to be related to the student's context to give meaning to learning, allowing the student to reflect on the relationships of nature beyond their everyday life.

Didactic Games and Gamification as Investigative Pedagogical Strategies for Teaching Science in Rural Education

Rural Education, like any educational context, should enable students to learn in a contextualized manner, as the practice of rural individuals requires an articulation between practice and theory (SANTOS; PORTO, 2020). According to Alves and Santos (2012), for Science education in Rural Education to be of high quality and tailored to the specifics of these individuals, four pillars should be part of the process: learning to know; learning to live together, as learning becomes easier when we share and exchange ideas and information; learning to do, from practice to theory; and learning to be, recognizing and valuing oneself as a subject in this process.

> In this context, when referring to the teaching of Science, we particularly recognize the significant need to develop pedagogical strategies that change the current teaching landscape, which is still focused on memorization. There is a search for a path that contributes to a teaching practice that effectively promotes student learning (CASAS, AZEVEDO, 2011, p. 82).

In this sense, teachers should consider resources that encourage practices that go beyond traditional content memorization. Games, as argued by Santos and Porto (2020), are effective motivational tools in the teaching and learning process. Friedmann (1996, p. 17) highlights that "playing is good and important," but poses the following question: "Is the game a means to achieve

certain goals or is it an end in itself?" With this inquiry, the author questions whether the objective of the game lies in the simple act of playing or if it can be an ally in constructing learning. We understand that a game can be considered an important tool for achieving a specific educational goal when the teacher has a clear intention, which should be reflected in planning and guidance. When the game has this purpose, it becomes defined as an educational game or pedagogical game.

Porto et al. (2020) state that educational materials are fundamental tools for the teaching and learning processes, and educational games are an important and viable alternative for supporting these processes, as they facilitate the construction of knowledge for students. Science content is often considered difficult and highly theoretical by students. Moreover, many teachers rely on activities that require memorization, neglecting the connection between theory and daily life, which leads to content forgetfulness. Therefore, Porto et al. (2020) highlight that games help to spark interest, creativity, and the desire to learn, making it easier for school activities to develop. They also help teachers assess students who do not participate in class discussions, as students involved in playful activities can participate without fear of peer or teacher judgment.

Gomes and Friedrich (2001) add that educational games aim to provide specific forms of learning and, therefore, differ from traditional pedagogical materials by incorporating a playful aspect and offering a more dynamic teaching method. Consequently, they help improve student performance in challenging scientific content, as noted by the National Curriculum Parameters (PCN), which recommend the use of educational games as a pedagogical strategy for teaching complex scientific topics (BRASIL, 2006).

In this sense, educational games are considered a valuable pedagogical tool as they make difficult lessons more accessible to all students and stimulate them to make decisions and cooperate through shared learning. They encourage teamwork, reduce student frustration, and improve interpersonal relationships. However, educational games only facilitate learning if the teacher has clear objectives and planning, ensuring that there is educational intentionality and that activities derived from the game are purposefully extracted. Additionally, Freire (2002) notes that educational games contribute to learning when they help students retain what has been learned, maintain existing knowledge, and memorize information by relating it to the game.

According to Vygotsky (1991), learning during educational games occurs through the interaction among students and the social conditions influenced by the game. Furthermore, educational games are a methodology that enhances learning and knowledge acquisition by using

auxiliary stimuli such as the student's cultural background, familiar language, and mechanisms that help students generalize concepts and problem situations presented in the game.

It is important to note that there is a wide variety of educational games, each with its specific objectives. The educator must choose the most appropriate game to achieve their pedagogical goals, especially in a specific context like Rural Education. Major types of educational games include: card games, such as *buraco, batalha, and copas*; board games, such as memory game, dominoes, pick-up sticks, and puzzles; tabletop games, like battleship, checkers, backgammon, tic-tac-toe, chess, and others; street games, including spinning tops, dodgeball, and hopscotch; and electronic games or video games, which are now considered educational given the digital age. These games allow players to pilot vehicles, explore different countries, and develop logical reasoning skills. The use of game strategies in educational contexts is referred to in the literature as gamification (ESPÍNDOLA, 2018).

Gamification involves thinking in terms of a game, applying game systems and mechanics outside of the game context (ESPÍNDOLA, 2018). Vianna et al. (2013) describe gamification as the use of game mechanisms outside the game to solve problems and to motivate and engage a specific audience.

It is worth noting that gamification is not a recent concept; its elements have long been used in education as a strategy to achieve learning through play. This approach involves not only game dynamics but also characteristic elements of gamification such as: goals, clear rules, immediate feedback, rewards, intrinsic motivation, incorporating mistakes into the process, fun, narrative, levels, reality abstraction, competition, conflict, cooperation, and voluntariness. Active strategies to achieve educational goals may not require the simultaneous use of all elements, but four are considered essential in any activity: voluntariness, rules, objectives, and feedback. Objectives guide participants toward achieving their goals; rules limit participants' actions; voluntariness refers to accepting the rules and objectives; and feedback provides information on progress (KAPP, 2012).

However, for the teacher to achieve their goals, it is crucial to know how to motivate students. Intrinsic motivation involves satisfaction derived from something of internal interest to the individual, leading to autonomy, skills development, and learning something new. On the other hand, extrinsic motivation is related to actions driven by external rewards. Both forms of motivation are challenging yet attainable for teachers, especially in the digital age, where traditional methods are still prevalent.

With this in mind, we believe that games and gamification can contribute to teaching and learning in rural education. They offer new ways of learning, aligning with the cultural and historical context of rural communities, which value play in activities like singing circles, games, and everyday

life. Through play, students engage in social interaction, exchange of knowledge, and use creativity and imagination with materials from their natural environment, such as sticks, stones, and leaves. These tools can enhance learning across various fields of knowledge pedagogically, stimulating interest, challenges, and curiosity in solving land-related problems through differentiated lessons. Incorporating this strategy in the environment where the student is born and grows up makes a significant difference for their development, as it integrates theory with their lived reality.

Methodological procedures

For the development of this study, we conducted a participatory research of a qualitative nature, which was carried out through a case study. The research was conducted in a Science class at a public rural school within the State Education Network of Bahia, located in the district of Maria Quitéria, in Feira de Santana-BA. The class consisted of 39 students attending the morning shift of the 8th grade of Elementary School at this institution; 35 students participated in the board game activity. Despite the large class size, we collected data from only 19 students, as they had signed and submitted the informed consent form, along with the consent form signed by their parents and/or guardians.

For data collection, we designed and implemented a Didactic Sequence (DS) for teaching the content of Adolescence and Human Reproduction. The DS was developed over a period of 12 classes and was applied by the researcher herself during her teaching period in the Pedagogical Residency Program[4], conducted at this rural school. Out of these classes, 11 lasted 50 minutes each, and 1 class lasted 1 hour and 40 minutes.

In addition, we used a logbook in which we recorded, among other points, the general aspects of the classes developed during the intervention, the motivation and/or engagement of the students, and the development of the activities proposed in the DS by the students (PORTO, 2014). This allowed us to analyze the context of data collection, to clarify the students' knowledge during the pre-test and after the post-test, using one of the activities in the sequence with the trail game, highlighting some elements of gamification, including rules, feedback, rewards, and levels as a means of stimulating the students.

[4] According to CAPES (2018), it is one of the actions that are part of the National Policy for Teacher Training and aims to promote the improvement of practical training in undergraduate teaching programs.

A Didactic Sequence for Teaching Adolescence and Human Reproduction

A Didactic Sequence (SD) is defined by Zabala (1998) as a set of coordinated and ordered activities based on educational objectives. Porto (2018) adds that an SD is organized through ordered and structured activities aimed at contributing to the realization of educational objectives, enhancing student engagement, and promoting learning and argumentation.

In this premise, the application of this methodology allowed students to gain a better understanding of the content related to *Adolescence and Human Reproduction*, and also helped us to qualitatively analyze the tools used. In Table 1, we present our SD:

Table 1: Didactic Sequence for Teaching *Adolescence and Human Reproduction*

Activity	Teaching/ Objective	Learning /Objective	Methodology	Number of Lessons
Diagnostic Activity	Map the Students' Prior Knowledge on *Adolescence and Human Reproduction*.	.....	Administer a questionnaire on the content to be covered, allowing students to answer based solely on their existing knowledge, without consulting any resources	One 50-minute class
Investigative Lesson on Growth and Changes in the Human Body	Discuss and analyze the physical changes occurring in the female and male bodies concerning sexual characteristics	Recognize the differences and implications of the changes occurring in their bodies	Watch video: Olho Clínico – Puberdade. Duration: 14:00 minutes. Followed by discussion and reflection on the concepts presented in the documentary.	One 50-minute class
Conducting the activity	Encourage students to report and reflect on the changes that have occurred in their bodies during puberty	Understand the importance of puberty for their life and the transformation that occurs during the transition from childhood to adulthood.	Apply the "String Art" activity: Distribute sheets of paper, string, glue, pencils, or pens to the students. They were asked to tie several knots in a piece of string and then glue them onto the paper to create any shape they desired. They were instructed to write next to each knot what bothers them most during adolescence. To conclude the activity, the group discussed the common issues that most bother adolescents	One 50-minute class
Investigative Lesson on the Male and Female Reproductive Systems	Present and discuss with students the parts and functions of the male and female reproductive systems	Understand the parts of each system and their functions	Divided into groups, each student chose a reproductive system to draw. Each student presented the functions of each organ to their peers, guided by the researcher.	One 50-minute class.
Expository Lesson: Presentation of Work on the Male and Female	Continue with the student presentations.	Ensure satisfactory learning about the studied topic.	The presentations continued, with the researcher intervening whenever necessary.	One 50-minute class.

Reproductive Systems				
Expository Class on Contraceptive Methods	Present and discuss various contraceptive methods.	Understand and classify various contraceptive methods and learn how to use them.	Watch an explanatory video about contraceptive methods. Afterward, the methods were classified and written on the board, with each one presented concretely, including the correct way to use them	One 50-minute class.
Application of the activity on the topic of Contraceptive Methods	Promote learning about Contraceptive Methods through an investigative strategy.	Understand contraceptive methods. Learn how to prevent pregnancy.	The study on the topic continued with students exploring truths vs. myths related to various contraceptive methods. The researcher brought a box containing questions about contraceptive methods and myths about them. The class was divided into two groups, and the students decided who would start the game by playing odds or evens. They then drew a card from the box, read it, and tried to determine if the statement was a myth or a fact. The researcher intervened whenever necessary.	One 50-minute class.
Investigative lesson on the topic of Puberty and Human Reproduction	Provide students with information on the topic of Puberty and Human Reproduction as a means to prevent teenage pregnancy, considering that some teenagers start their sexual life unprepared. This estimate increases when it comes to rural adolescents, possibly due to a lack of information or access to healthcare	Assimilate the topic of Human Reproduction in a meaningful way.	Resolution of problem-solving scenarios on the topic of Puberty and Human Reproduction as a means of preventing teenage pregnancy.	One 50-minute class.
Presentation and Application of the Board Game "Trilhas"	Inform the rules of the game; determine the number of participants per group; explain the types of questions, and other relevant informatio	Learn in a playful, enjoyable, and contextualized manner about topics related to adolescence and human reproduction.	Implementation of the didactic game "Trilhas." The questions focused on the content of adolescence and human reproduction. Initially, the researcher presented the game, explained how to play, and outlined the rules.	Two Classes of 1 hour and 40 minutes Each.
Post-test Diagnostic questionnaire	Know the level of learning of students	Review the content studied on the topic of puberty and human reproduction.	Application of an activity composed by contextualized problem situations regarding the content of the intervention.	One 50-minute class.

Source**:** Field research (2019).

Initially, we presented to the students the course plan and the objectives to be achieved, as well as some rules. We explained that the content would be divided into phases, each corresponding to a specific topic of adolescence and human reproduction (physical and psychological changes in adolescents, menstrual cycle, contraceptive methods, pregnancy/abortion), and that an evaluation would be conducted at the end to assess learning. It was clarified that the tasks (individual activities, game application) would count as points for the unit.

In the implementation of the diagnostic activity, which marked the beginning of the didactic sequence, 31 students participated. To develop this sequence, initial meetings were held with the research group to discuss its construction. Upon analyzing the responses, we found that the students had significant difficulties with aspects related to the topic:

> Girls at the beginning of puberty tend to undergo body changes and reach the approximate height of an adult at 17 years and boys up to 18 years?

In this question, fifteen students answered incorrectly, possibly due to a lack of understanding of the periods, changes, and transformations that occur during puberty, or because they did not have someone to clarify their doubts. They might not have understood that it is a natural process and that it is important not to follow societal parameters. However, in the post-test responses, we observed that most students were able to grasp the studied content by addressing the same question.

We will now present another question that refers to the diagnostic activity:

> Can a pregnancy test be done only through urine? Justify your answer.

In this question, we expected fewer doubts since it is a relatively simple query with considerable access to information today. However, analyzing the responses from the students in this activity, we found that 21 students answered this question incorrectly, meaning most were unaware that there are other ways to confirm pregnancy, such as the Beta HCG blood test, which detects a hormone produced during pregnancy to maintain it. This result indicates that the lack of information in this regard contributes to higher rates of teenage pregnancies during this period.

In the post-test, we sought to assess the possible contributions acquired through the activities of the didactic sequence regarding *Adolescence and Human Reproduction*. When asked about:

> Are oocytes produced in the ovaries?

Twenty-eight out of the thirty-five students answered correctly, indicating that they acquired knowledge about the female reproductive system. In another question asked during the post-test*:*

> Do contraceptive methods prevent fertilization or the implantation of the embryo in the uterus?

In this question, the students demonstrated their knowledge by correctly answering that it is true, leading us to believe once again that learning likely occurred, recognizing that one of the functions of contraceptive methods is to prevent unwanted pregnancy. In the next question, we asked:

> Is HPV (Human Papillomavirus) a group of viruses that can cause warts in the genital area and may lead to tumors such as cervical cancer?

The students answered correctly with "true," identifying the virus as one of the STDs that affect women during their reproductive years.

We began the dialogical classes on the topic, and throughout, we observed that there was interest and motivation from the students, as the studied content sparked curiosity. This was a topic that adolescents often did not discuss with their parents, and the school provided an opportunity to clarify most of their doubts. Initially, the students were shy and embarrassed to talk about changes related to their bodies, but gradually they felt more comfortable asking questions. During the debates, there was an exchange of knowledge, a change in language, exposure to and distribution of contraceptive methods, and information through printed materials (magazines, pamphlets).

These strategies helped the students access specific information, learn to interact in groups, debunk myths regarding the topic, feel confident in answering questions scientifically, understand the changes occurring in their bodies, and prevent unwanted pregnancies and sexually transmitted diseases.

The Giant Trails game was made with 36 sheets of colored E.V.A paper, 10 meters of black TNT, styrofoam glue, 3 colored cones (orange, green, and blue), a styrofoam board to track scores, a bingo game to draw questions, and treats (candies, chocolates, lollipops, popcorn) as rewards for each correct answer, providing status and challenges. It is noteworthy that the creation of the trails game was a production of the researchers. We chose this strategy to save time, as it was not feasible for the students to create it due to the limited time available.

We opted for this type of game because it could be practiced outside the traditional classroom context, providing movement and freedom, which young people appreciate, as well as engagement and motivation. Working with gamification elements, such as rules, feedback, rewards, and levels, consists of recontextualizing the content of the intervention to promote the development of cognitive skills.

At this stage, the class was divided into three groups. The researcher indicated the color of the vest used during the game. This strategy stimulated competitiveness, established rules for the game to function, and set objectives that could be achieved, as well as the location of the activity. Dice were

rolled to determine each group's position during the game. We used a bingo with numbers from 01 to 36 to draw the questions to be answered by the group according to their position (1st, 2nd, and 3rd) on each turn. If the group could not answer, it passed the turn to the next group. Each mistake provided a new chance to succeed, as at the end, we revisited the questions that students were unable to answer at the time. The game included questions at basic, intermediate, and advanced levels, named as "bomb questions," such as: *"Is the vas deferens a tube with a muscular wall that carries the eggs from the epididymis to the urethra*?" To answer this question, students had to justify their response rather than just answer true or false.

At this stage, we highlighted the gamification element through the basic, intermediate, and advanced levels, which were seen as progressions for the students.

The post-test consisted of an investigative tool aimed at cross-referencing data and generating diagnostics regarding the indications of learning presented by the students as a result of the intervention. This activity was designed with problem-situations related to adolescence and human reproduction. Our goal with this activity was to analyze the students' learning through the use of the Didactic Sequence (SD), combined with the game and gamification elements present in the intervention.

Finally, the final assessment. In this activity, scores from the diagnostic activity, post-test, and the questions from the Giant Trails game were considered. As a proposed task, students were to achieve the highest score on the answered questions. No specific time limit was set, allowing students to proceed at their own learning pace. During these interactive practices, it was expected that learning would be promoted, as students were encouraged to participate and play until their objectives were met. Thus, learning was built collectively. Missions and challenges were established, and prizes were awarded both at the end and throughout the activity. The game facilitated knowledge mediation, improved focus, and the integration of theory and practice, and also provided a dialogical action among the students (FREIRE, 2015), as mutual respect, listening, and collaboration were necessary. Through dialogue, students reached agreements on answers, thereby solidifying their learning process.

Development of the Educational Game "Trilha" in the Investigative Context: Reflections on the Intervention Context

When we began the investigative activity, we received support from two teachers: one from the Arts department and one from the History department, who made their class times available for us to

apply the educational game of "Trilha." We also had the assistance of a colleague who filmed the entire activity. The game was conducted in the institution's auditorium, as we needed a spacious area due to the game's requirement for movement. The activity lasted 2 hours and 30 minutes, starting at 8:30 AM and ending at 10:30 AM, and involved 35 students.

Before starting the development of the educational game, the researcher distributed printed rules of the game. Thus, at the beginning of the practical activity, the rules were read aloud. Subsequently, the class was divided into 3 groups, with two groups consisting of 12 participants each and one group with 11 students. This organization, as emphasized by Zabala (1998), promotes diversity of opinions and knowledge, contributing to increased student engagement in the activity.

We distributed vests according to the randomly drawn colors (orange, green, and blue). Then, one student from each group played odd or even to determine the groups' positions (1st, 2nd, and 3rd). Students were lined up according to their leader's choice to answer the drawn question. Whether they answered correctly or not, the turn would pass to the next group, according to the position. When answering correctly, the student received a prize (chocolate, snack, lollipop, etc.); when drawing a question, the student would place a pin of their drawn color on the number. It is worth noting that during the educational game, no materials (books, notebooks, cell phones) were consulted, and the points achieved were recorded by the auxiliary teacher on a scoreboard mounted on the wall for everyone to follow the results.

Figure 1: Reading the Rules

Source: Own files (2019)

Figure 2: Participating Groups

Source: Own files (2019)

The game had an inclusive character, as no one was left out; everyone stayed until the end. The winning team would be determined by the number of correct answers. In the end, all students were graded in the subject of Science, but the winning team received the highest score in the partial assessment.

Figure 3: Application of the educational “Trilha” game

Source: Own files (2019)

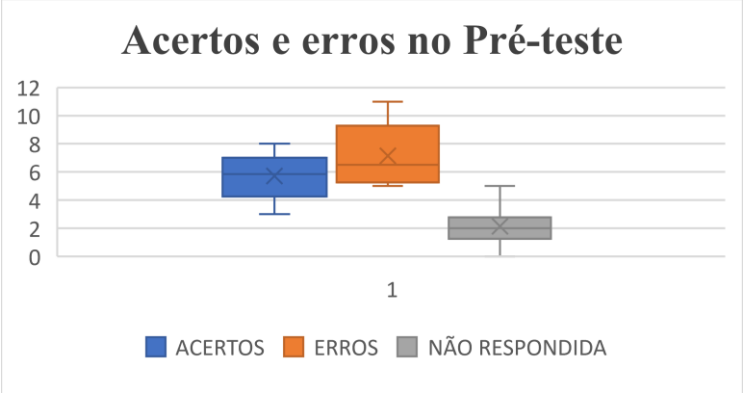
Only the group with the blue vests did not perform satisfactorily, possibly because its members did not pay attention in class and did not engage in the activities. However, the other groups demonstrated confidence in answering the questions during the game and, in some cases, were able to justify their answers. This supports Santos's (1998) ideas that the game can be used as a learning tool because it stimulates students' interests, fosters new discoveries, and brings students closer to scientific knowledge. Additionally, Vygotsky (2007) complements this by stating that learning occurs through interactions with the social environment. This was evident in the game, as the group activity allowed interaction among students and the application of their knowledge, with those who had more knowledge helping others.

Contributions of the Didactic Sequence to Learning About Adolescence and Human Reproduction

In this section, we present the analysis of students' performance in the diagnostic activity and the post-test. For this, we considered the number of errors and correct answers for each question presented in both activities and the scores achieved by each student in each of these. The data were presented in graphical format to compare the two activities and observe the learning indications shown by the students about the content of the Didactic Sequence.

In Graph 01, we present the average number of errors and correct answers in the pre-test to map the students' prior knowledge about the content of the Didactic Sequence:

Graph 1: Average Number of Errors and Correct Answers in the Diagnostic Activity

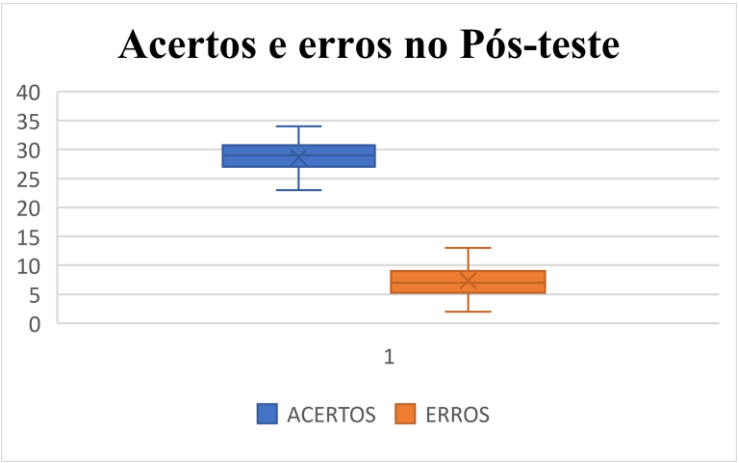


Source: Research Data (2019).

These results indicate that the majority of participating students likely did not have access to information regarding Adolescence and Human Reproduction, particularly concerning the changes occurring during this period, contraceptive methods, and Sexually Transmitted Diseases (STDs). The number of errors and unanswered questions leads to this conclusion. A significant factor contributing to this issue may be the lack of information and family support, as the family plays a crucial role in biological, social, and psychological aspects (OSÓRIO, 1996). Therefore, it is essential for parents to provide their children with the initial guidance on these topics.

In Graph 02, we present the average number of errors and correct answers in the post-test to map the knowledge acquired by students during the SD:

Graph 2: Average Number of Errors and Correct Answers in the Post-Test



Source: Research Data (2019).

These results highlight the contributions of the SD (didactic sequence) to learning through the game and gamification elements. We can consider these results satisfactory, as the students engaged

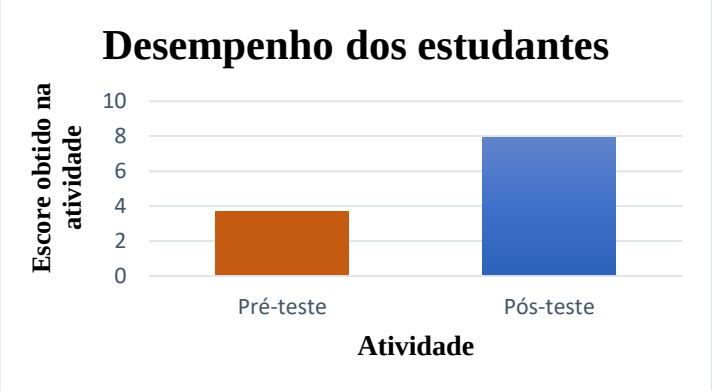
in investigative and stimulating practices that motivated and involved them in learning the content, directly contributing to their learning.

Another relevant factor that may have contributed to the success of these activities is the interaction and cooperation among the groups. According to Vygotsky (1987, p. 43), "a person is produced in and through language, that is, it is in interaction with others that ways of thinking are constructed through the appropriation of the knowledge of the community in which one is embedded." Thus, we observe that such investigative strategies facilitated the appropriation of knowledge, sparking interest in changing attitudes and transforming students' behaviors. Regarding this aspect, Zabala (1996) *apud* Silva (2006) adds that:

> [...] the construction of certain concepts and/or skills may be linked to a more active, critical, and reflective methodological strategy, allowing for meaningful learning that is close to the student's reality and appropriate for their age group (SILVA, 2006, p. 143).

We support the ideas of the authors, as we believe it is necessary to choose activities suitable for each student group based on their age to ensure interest and motivation. In the didactic sequence (SD), this reflection is evident from the analysis of the development of the "Trilhas Gigantes" game. This game provided students with moments of relaxation, movement, and freedom elements that young people greatly appreciate and which are crucial for promoting science education through investigation.

Graph 3: General performance of students in the SD



Source: Research Data (2019).

The result of students' performance in the post-test differs from the diagnostic activity, as it shows significant improvement compared to the first activity. This improvement was observed through the number of correct answers between the two activities. This result is quite evident, and from this, we reinforce the idea of how playful strategies contribute to knowledge construction.

Therefore, based on the results obtained, we affirm that the educational game "Trilhas Gigantes" contributed to the learning of the covered content, as we noticed that the number of correct answers almost doubled in the post-test compared to the diagnostic activity. These results highlight that the game fulfills its objective, proving to be another effective strategy in the investigative teaching and learning process for Science education.

Vygotsky (1989) adds that play can be considered a strong ally in promoting learning, as playfulness enhances concentration, curiosity, initiative, and self-confidence. For this to be possible, classes need to move away from traditional proposals, as provided by the proposed SD.

It was noticeable that through the SD, the involved students learned to coexist with different ideas, to learn from others, and to commit to their studies, as most were initially unable to engage in the proposed activities but became participatory with these activities. We observed that the game and gamification elements contributed to engagement and interest in learning about A*dolescence and Human Reproduction.* Beyond the playful and the game itself, Zichermann and Cunningham (2011) emphasize that gamification uses game mechanics such as challenges, rules, levels, and rewards to turn daily activities into playful ones. In our SD, these elements were used as incentives to help students overcome obstacles in learning about *Adolescence and Human Reproduction*, making them attracted to the game, as challenges act as fuel to motivate learning.

The integration of games into the teaching and learning context, according to Grando (2001), implies limits and possibilities. Therefore, we can cite a range of advantages in using games to achieve certain content: fostering creativity, critical thinking, better observation of facts, development of strategies, student motivation, the revival of pleasure in learning because it is enjoyable and not mandatory, facilitating connections with what has already been learned and with their lived reality. Thus, the game allows for the socialization of knowledge, making it accessible to all, thereby promoting awareness of collective work.

Zichermann and Cunningham (2011) add that there are several reasons to motivate people to play, including mastery, fun, competition, and victory. In the context of Science education, both games and gamification contribute to stimulating students to learn the content being worked on, while they have fun, compete with their peers, and are rewarded for correctly answering questions and achieving victory, aiming to score higher in the Science discipline.

The teacher plays a relevant role in this process, needing intentionality and planning in their predetermined objective. It is also necessary for the student to have an interest in learning because

the game alone does not teach; it contributes to engaging students in achieving success in a particular activity and in Science education in the rural setting, where cooperation among people and collectivity in learning and teaching as a group are essential. In this regard, Caldart (2000, p. 53) adds that "the pedagogical process is a collective process, and therefore, it needs to be conducted collectively, rooting and helping to root people in strong collectivities," which are crucial for Science education in rural areas.

It is important to report the students' satisfaction with participating in activities outside the usual classroom context. Despite the contributions we have outlined and highlighted in this text, we note that there were some difficulties encountered in developing this SD, such as: coordinating the schedules of the institution's teachers with the application of the trail game; the lack of time for students to create the game; and the absence of financial resources to purchase vests and prizes. Even with these difficulties, it was rewarding to develop these pedagogical activities and observe that they are simple, planned actions that can enhance and potentiate teaching and learning. For success, it is necessary to understand for whom one is planning, as highlighted by Luckesi (2011).

Final considerations

The results presented highlight the potential of educational games and gamification elements. Our research demonstrated that these strategies contributed to stimulating, motivating, and engaging the students who participated in the intervention. We observed that the use of these strategies and the development of the SD contributed to the learning of various scientific concepts related to *Adolescence and Human Reproduction*, as well as to their contextualization, considering the rural context. Thus, we emphasize the importance of moving away from traditional teaching practices in the school environment to enhance the quality of teaching and learning in Science education in rural areas.

Our results demonstrate the significance of games and gamification elements as engaging and motivating strategies in this process. It is also worth noting that, according to Vygotsky (1934), social interaction fosters knowledge, as students, while answering questions during the trail game, consulted each other and showed increased cooperation and integration.

We can conclude that these methodological possibilities add new knowledge, bring ease to the teaching and learning process in Science education in rural areas, and promote the exchange of

knowledge and interest in scientific concepts. However, educational games are still seen by some educators as mere recreational activities, perhaps due to a lack of training, complacency, or insufficient time for planning. Therefore, we highlight the importance of ongoing professional development to address various issues that may arise in the professional practice of Science teachers in rural education, so that they can remain attentive to these new demands.

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