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Gamification in the teaching of matter and energy in the sixth year of basic education (Original)

La gamificación en la enseñanza de la materia y energía en sexto año de básica (Original)

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Abstract

This research stemmed from difficulties identified in the teaching learning process of the Matter and Energy curriculum block within the Natural Sciences subject for sixth-grade students at Zoilo Rodríguez Educational Unit in the Sozaranga canton of Loja province. The diagnosis results revealed limited use of active learning methodologies, particularly gamification, and a weak connection between the content and everyday life. Therefore, the study aimed to design gamified learning activities to improve the teaching and learning process from a constructivist, inclusive, and meaningful perspective. A mixed-methods approach was used, specifically a descriptive field study. Theoretical, empirical, and statistical methods were combined, and techniques such as surveys, interviews, and participant observation were used. The proposed activities were evaluated by specialists, who determined their relevance and feasibility. It was concluded that gamification, when integrated into the teaching of Natural Sciences, promotes active student participation and meaningful learning, provided it is combined with the principles of Universal Design for Learning and the necessary resources are available for its systematic

application. The proposal is consolidated as an innovative didactic alternative to transform educational practice in rural contexts and strengthen students' interest in Natural Sciences.

Keywords: didactic activities; gamification; teaching and learning; matter and energy

Resumen

La investigación se desarrolló a partir de las dificultades identificadas en el proceso de enseñanza- aprendizaje del bloque curricular Materia y Energía de la asignatura Ciencias Naturales sexto año de básica en la unidad educativa Zoilo Rodríguez del cantón Sozaranga provincia de Loja. Los resultados del diagnóstico revelaron limitado uso de metodologías activas en el proceso de enseñanza aprendizaje, particularmente de la gamificación, y escasa vinculación entre los contenidos y la vida cotidiana. Por lo que el objetivo del estudio estuvo dirigido hacia el diseño de actividades didácticas basadas en la gamificación para mejorar el proceso de enseñanza aprendizaje desde un enfoque constructivista, inclusivo y significativo. La metodología utilizada fue mixta; el tipo estudio descriptivo y de campo. Se combinaron métodos teóricos, empíricos y estadísticos, y se utilizaron técnicas como la encuesta, la entrevista y la observación participante. Las actividades propuestas fueron valoradas por criterio de especialistas, quienes determinaron su pertinencia y viabilidad. Se concluyó que la gamificación al integrarse en la enseñanza de las Ciencias Naturales promueve la participación activa del estudiante y el aprendizaje significativo, siempre que se combine con los principios del Diseño Universal de Aprendizaje y se cuente con los recursos necesarios para su aplicación sistemática. La propuesta se consolida como una alternativa didáctica innovadora para transformar la práctica educativa, en contextos rurales y fortalecer el interés de los estudiantes por las Ciencias Naturales.

Palabras claves: actividades didácticas; gamificación; enseñanza aprendizaje; materia y energía

Introduction

Natural Sciences are an essential pillar in the comprehensive development of elementary school students, as they foster curiosity, critical thinking, and an understanding of the natural environment that surrounds them. Through the study of this area of knowledge, students learn to observe, experiment, formulate hypotheses, and reflect on the phenomena of the world, building the foundations of scientific thinking. In the Ecuadorian curricula, a unit within this subject is dedicated to the study of Matter and Energy, a topic that occupies a relevant place in the student's scientific training because it addresses fundamental concepts about matter, its structure, physical

and chemical transformations, and the various forms of energy and their responsible use. The Matter and Energy curriculum unit promotes the understanding of natural phenomena present in everyday life; therefore, its teaching should aim toward the development of research skills, the strengthening of logical reasoning, and the stimulation of meaningful learning. This requires the use of methodologies that encourage active participation and experiential learning among students.

Within these methodologies, gamification has gained particular relevance in recent times due to its dynamic and innovative nature, and its ability to place the student at the center of their own learning. Recent research highlights the importance of gamification in the teaching of Natural Sciences, as is the case of Manassero & Vázquez (2023), who designed a cooperative card game to teach the nature of science in an innovative way in primary school. They based their proposal on the theory of learning games and on the explicit and reflective pedagogy required for teaching Natural Sciences. The results of this study demonstrated the benefits of the game in student learning, as well as some alternatives for improvement and limitations of the card game experience with respect to teaching Natural Sciences in primary school.

In Ecuador, Mallitasig & Freire (2020) conducted research to measure the learning achievements in Natural Sciences of ninth-grade students before and after the use of tools such as Kahoot and Plickers. Through statistical analysis, they determined a considerable increase in students' learning strategies in Natural Sciences. They concluded that gamification positively influences the student learning process because it is an innovative pedagogical technique that combines game elements so that students internalize knowledge and experience learning as a positive and satisfying experience.

The study conducted by Ramírez (2023) focused on the area of Educational Technology and Invention, specifically in the area of Natural Sciences, with the objective of analyzing gamification as a technique for the teaching-learning process in Natural Sciences. The author followed a qualitative methodology, based on document analysis. The common thread running through the findings of the consulted studies focused on the value of new Information and Communication Technologies (ICTs) as a resource for achieving educational objectives. García et al. (2024) analyzed the use of gamification as a pedagogical strategy in the teaching of Natural Sciences, examining how the implementation of gamification techniques in the educational environment can enhance academic achievement in Natural Sciences. The experimental group

engaged in gamified activities through digital platforms such as Kahoot, Classcraft, and Quizizz, while the control group followed a conventional teaching approach. The results obtained in this research demonstrated that the implementation of gamification strategies generated a significant effect on students in the experimental group in terms of motivation, engagement in learning, and increased academic performance compared to participants in the control group.

On the other hand, Pinenla-Palaguaray et al. (2025), propose a didactic strategy for teaching natural sciences based on constructivist approaches, with the objective of promoting meaningful, collaborative, and contextualized learning through an organized sequence of four phases. Each phase includes specific actions accompanied by activities designed to awaken scientific curiosity, build knowledge, apply concepts in real-world contexts, and communicate results rigorously and creatively. The proposal contributed to addressing contemporary challenges in science education by integrating local and global knowledge and fostering ethical and social reflection.

Despite these findings, it is important to highlight that the teaching of Natural Sciences in Ecuadorian basic education, especially in rural contexts, faces multiple challenges, including: a lack of teaching resources, poorly equipped laboratories, teachers with limited mastery of active methodologies that place the student at the center of the learning process, and the existing gap in access to technological resources and limited digital connectivity. Zoilo Rodríguez Educational Unit is not exempt from this problem. Natural Science teachers still employ traditional methodologies that limit student participation in their learning process; in many cases, the content covered does not address real-world problems in the community, and the use of gamification is limited, as is the use of accessible and interactive technological resources. This situation affects the performance of sixth-grade students who show little interest in learning the Matter and Energy curriculum unit. Based on the diagnostic results, the following research problem is posed: How can the teaching - learning process of the Matter and Energy curriculum unit within the Natural Sciences subject be improved in the sixth grade at Zoilo Rodríguez Educational Unit in the Sozoranga Canton, Loja Province?

The general objective is to propose gamification-based activities that improve the teaching and learning process of the Matter and Energy curriculum unit within the Natural Sciences subject in the sixth grade at Zoilo Rodríguez Educational Unit.

Materials and Methods

The research employs a mixed-methods approach (qualitative and quantitative), allowing the authors to delve into the teaching and learning process of the Matter and Energy curriculum block within the sixth-grade Natural Sciences subject. This approach aims to identify pedagogical practices, interactions, perceptions, and barriers to student learning. The research is exploratory and field-based, conducted at the Zoilo Rodríguez Educational Unit. This ensures the direct collection of information from those involved in the phenomenon under study, without altering or manipulating the variables. This facilitates the development of conclusions and the proposal of didactic alternatives that contribute to solving the research problem.

The study utilizes various research methods for a better understanding of the problem. Among the theoretical methods are analysis and synthesis, used to systematize the theoretical frameworks on the teaching and learning process of the Matter and Energy curriculum block within the Natural Sciences subject, as well as gamification. The information gathered provides the authors with a holistic view of the phenomenon under investigation. The inductive-deductive method is employed during the diagnostic phase, allowing for conclusions to be drawn and a solution to be proposed for the investigated problem. Among the empirical methods used are scientific observation, interviews, and surveys to obtain information on the teaching and learning process of the Matter and Energy curriculum block. The statistical mathematical methods employed include percentage analysis and descriptive statistics, which allow the authors to process quantitative information, interpret the data, and represent it. Finally, expert opinion is used to evaluate the proposed activities.

The research takes place in its natural context, that is, at Zoilo Rodríguez Educational Unit, specifically in the sixth year of Basic General Education, during the 2024-2025 academic year. The institution is located in the Tacamoros Parish, in the Sozoranga Canton, Loja Province. Due to the authors' interest and its accepted mythological basis, the research involves the entire population, consisting of 16 sixth-grade students and three teachers who teach Natural Sciences at the institution.

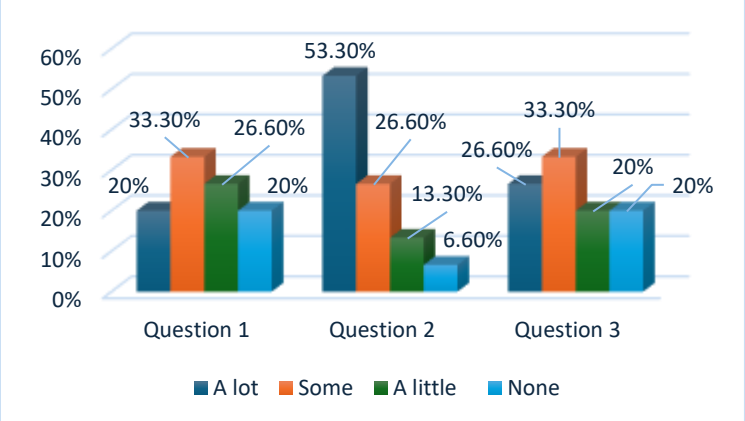
The research is developed through three stages: diagnosis, design of didactic activities based on gamification, and the third stage of implementation and evaluation of the proposed activities. This process is carried out using expert criteria, which guarantees the relevance and feasibility of the proposal.

Stage 1. Diagnosis: This stage aims to identify the needs and potential of the teaching and learning process of the Matter and Energy curriculum block and the use of active methodologies such as gamification. Techniques used in this stage include a survey using a closed-ended questionnaire administered to 15 sixth-grade students; interviews with structured questions; and participant observation.

Analysis and discussion of the results

The results of the survey of sixth-grade students reveal their limited engagement in learning Natural Sciences. In the first question, only 20% of students expressed a strong liking for the subject, while more than half showed little or no interest. This suggests that traditional teaching methods do not generate the necessary interest to spark scientific curiosity in students. However, when analyzing the second question, a significant change is observed: 53.3% of the students surveyed stated that they greatly enjoy it when the teacher uses games, 26.6% somewhat enjoy it, 13.3% somewhat enjoy it, and 6.6% do not at all enjoy the use of games in teaching this subject. This demonstrates the impact that active methodologies such as gamification have on students' motivation and interest in their learning. In the third question, related to interest in the topics of matter and energy, the results again show a pattern similar to the first question: only 26.6% expressed high interest, while 40% expressed little or no interest, as shown in Figure 1.

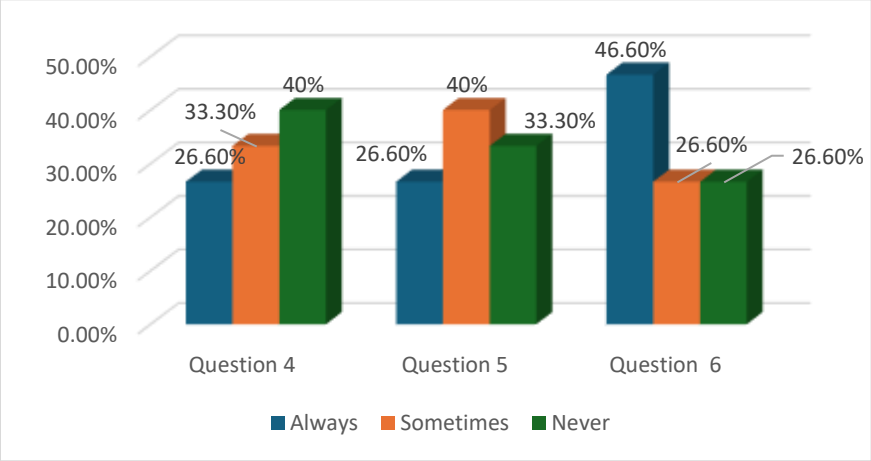
Figure 1. Results of the first three survey questions



Source: Authors' own elaboration

The results obtained in the last questions reflect significant challenges in the teaching of Natural Sciences, specifically in topics related to Matter and Energy. In question four, only 26.6% of students responded that the teacher always explains Matter and Energy topics using everyday examples, 33.3% said sometimes, and 40% stated never (see Figure 2).

Figure 2. Results of the last survey questions



Source: Authors' own elaboration

This indicates that the teaching strategies used by teachers do not connect new knowledge with prior knowledge, nor do they take into account students' experiences and realities. When this occurs, the opportunity for learning to be meaningful and relevant to them is lost. In question five, the results follow a similar pattern: 26.6% of students responded that the teacher always uses games to teach Natural Sciences, 40% responded that they are used only sometimes, and 33.3% said they are never used. This suggests that, despite evidence of the importance of games as a teaching tool to foster curiosity, participation, and the understanding of abstract concepts, their incorporation into classrooms remains limited. Cooperative learning presents a more encouraging picture: 46.6% of students report always participating in group activities, while only 26.6% say they never do. This fosters the development of social skills, communication, and problem-solving abilities. Finally, students' perceptions of games as a learning tool demonstrate their pedagogical effectiveness: 53% of students believe that gamification helps them learn Matter and Energy topics better, while only 7% feel it is of no help. These results demonstrate the need to promote active, contextualized, and cooperative methodologies that place students at the center of their learning and allow science to be explored and understood through everyday experience.

These results demonstrate that the implementation of active methodologies such as gamification allows students to understand abstract phenomena and concepts in an experiential and fun way, fostering scientific curiosity and the meaningful construction of knowledge; the game ceases to be mere entertainment and becomes a pedagogical tool that enhances creativity, motivation, and critical thinking. Segura (2019, cited by Franco, 2023), considers gamification a

powerful tool to help motivate students in class and thus facilitate the teaching and learning process.

For his part, Werbach (2012, cited by Zambrano et al., 2020), proposes the following as the foundations of gamification: dynamics, mechanics, and components. Dynamics are the concept, the implicit structure of the game. The mechanics are the processes that drive the game's development, and the components are the specific implementations of these dynamics and mechanics: avatars, badges, points, collections, rankings, levels, teams, and so on. The interaction of these three elements is what generates the gamified activity.

The results of the interview conducted with sixth-grade Natural Science teachers at the Zoilo Rodríguez Educational Unit, and of the participant observation of the teaching and learning process of the curriculum block: Matter and Energy, show a certain consistency with the data obtained in the student survey. Teachers agree that the main difficulties students face in learning about Matter and Energy are related to a lack of connection between concepts and reality, as well as a weak foundation of knowledge acquired in previous grades. This leads them to perceive the content as abstract and meaningless, especially the more complex topics related to energy.

Regarding the methodology used in teaching Natural Sciences, teachers state that they employ active methods and strategies that promote student participation, citing lectures, simple experiments, cooperative work, and project-based learning. However, these statements contrast with the results of the survey and observation, which reveal a predominance of teacher-centered lectures and limited use of strategies that encourage knowledge construction based on student experience. In the observed classes, there is a noticeable lack of use of methodologies that stimulate scientific curiosity and allow for contextualizing the content. Regarding meaningful learning, teachers maintain that they connect the topics of matter and energy with everyday examples.

However, observations show that this practice is not carried out systematically; the most frequently used resources in the classroom are videos, posters, and textbooks, demonstrating a reliance on traditional materials and a limited use of more interactive experimental resources. Although teachers recognize the value of gamification, the observed classes revealed that the application of these strategies is scarce. While there is a positive attitude toward these methodologies, most teachers report lacking the necessary training and tools to implement them systematically in their teaching practice; this deficiency limits the possibility of transforming

Natural Sciences into an active and meaningful experience. These data reflect that student motivation depends largely on the pedagogical strategy employed. When learning is presented in a playful, participatory, and contextualized manner, students feel motivated and engaged in their own learning.

Stage 2. Design of gamified learning activities.

The teaching and learning process of Natural Sciences in Ecuadorian Basic General Education is an essential space for students to understand the world they live in, develop critical thinking, and acquire a responsible attitude toward environmental problems. The Ecuadorian curriculum model promotes an active, reflective, and investigative approach, where learning stems from curiosity, observation, and experimentation as means to construct meaningful scientific knowledge (Ministerio de Educación del Ecuador, 2016). The teaching of Natural Sciences must move beyond traditional practices focused on memorizing concepts and give way to active methodologies that stimulate inquiry, the formulation of hypotheses, and the search for well-founded explanations of natural phenomena. In this sense, Meneses (2010, cited by Ávila et al., 2018), considers the teaching-learning process as an intentional communication system that occurs within an institutional framework and in which strategies are generated to promote learning. Barrera & Bonilla (2018, cited by Bernal et al., 2024), propose that the teaching-learning process is communicative because the teacher organizes, expresses, socializes, and provides scientific, historical, and social content to the students, who, in addition to constructing their own learning, interact with the teacher, with each other, with their families, and with the surrounding community, applying, debating, verifying, or contrasting said content.

In this stage, gamified learning activities are designed to improve the teaching and learning process of the Matter and Energy curriculum block, fostering greater student involvement and commitment to their own learning. All proposed activities integrate the basic principles of gamification and Universal Design for Learning (UDL), promoting cooperative and experiential learning.

Activity 1. Building Molecules

Skill: CN.3.3.2

Objective: To understand the formation of molecules from the bonding of atoms through a playful and hands-on experience.

Resources: Molecular modeling kits or modeling clay, toothpicks, guide cards, digital whiteboard.

Time: 80 minutes.

Procedure:

The teacher explains the difference between atoms and molecules, then demonstrates with simple examples (H_2O, CO_2, O_2) how to represent bonds and geometry; shows presentation criteria. Distributes cards with formulas and levels (basic, intermediate, advanced). Provides visual support templates for students with difficulties (diagrams, labels). Asks inquiry questions and records lists of evidence. Students build models (kits/modeling clay/toothpicks) following these steps: 1. Identify the type of atom and valence; 2. Assemble the model; 3. Write down the name and emergent properties; 4. Prepare a 2-minute explanation and present your results to the class. Gamification incorporates mini-challenges (for example, building the lightest molecule) and points for creativity and accuracy. Presentation options include oral presentation, poster, or short video (UDL).

Assessment: Observation rubric focused on the correct representation and oral explanation of the molecular model.

Activity 2. The Mystery Mixtures Lab.

Skill: CN.3.3.3

Objective: Classify different types of mixtures, recognizing the differences between pure substances and mixtures.

Resources: Salt, sugar, water, sand, iron filings, beakers, spoons, magnets, labels.

Time: 80 minutes.

Procedure: The teacher introduces the topic with a short video and poses the challenge: Which of these samples is pure and which is a mixture? Four stations are set up (dissolution, filtration, magnetic separation, microscopic observation). Before starting, visual instructions and a UDL checklist (steps with pictograms and text) are provided. Supervises and briefly models each technique, formulates research questions, and provides scaffolding for students with needs. Groups rotate for 10 minutes through each station: they perform the procedure, record observations (appearance, changes, solubility, response to the magnet), take a photo, and label the sample on a collaborative template. They identify whether the sample is a pure substance, a homogeneous mixture, or a heterogeneous mixture, and justify their answer with evidence. Each

correct decision earns points and lab badges; errors are used as correction clues (formative feedback). Teams exchange results, the teacher moderates a guided discussion to build concept, and concludes with a synthesis. Feedback is provided using a rubric and checklist.

Assessment: Checklist of the experimental process and self-assessment of teamwork.

Activity 3. Cooperative Classification Activity.

Skill: CN.3.3.3

Objective: To classify pure substances from mixtures using a cooperative classification activity.

Resources: Cards with images and descriptions of materials, wall board, adhesive tape. Time: 40 minutes.

Procedure:

The teacher describes the activity and presents the physical and digital mural with categories: pure substances, homogeneous mixtures, and heterogeneous mixtures. Modeled examples are also provided. Students form groups and assign roles: advocate (explains the choice), recorder (documents), verifier (compares with the guide), and communicator (presents the results). The teacher distributes packets of cards with images, descriptions, and properties, and assigns classification criteria. A support sheet with visual cues and definitions in various formats is provided. The teacher monitors progress and poses follow-up questions for advanced teams. The groups select the cards, justify their choices, and paste them onto the mural. Each accepted justification earns points; the most creative justifications receive recognition. The teams present and defend their murals in a plenary session. The teacher provides feedback.

Evaluation: Checklist: Participation and cooperation are evaluated, as well as coherence in the classification of materials, creative justifications, and clarity of presentation.

Activity 4. Chemical Detectives.

Skill: CN.3.3.4

Objective: To recognize chemical compounds in everyday objects and classify them as organic or inorganic.

Resources: Household products (vinegar, sugar, detergent, salt), observation sheets, magnifying glass, camera or tablet.

Time: 120 minutes (3 sessions).

Procedure:

The teacher presents the case and the safety protocol. They explain what a chemical compound is with everyday examples. Students form groups and assign roles. The teacher provides real materials and labels, guides students in reading labels, and shows them how to find information in reliable sources. They ask clarification questions and verify sources. The groups analyze 5–7 household products, identify compounds, classify them as organic or inorganic, and record the evidence (labels, photos). They prepare a presentation, which can be a role-playing exercise where each member defends their classification. Points are awarded for correct use of evidence, clarity, and creativity. The final report can be written or audiovisual.

Evaluation: Report with criteria for accuracy, presentation, and group reflection.

Activity 5. Project: The Chemical Home.

Skill: CN.3.3.4

Objective: To apply knowledge about chemical compounds through a cooperative project that identifies their presence in the home.

Resources: Recording sheets, camera or cell phone, computer, poster board or digital slides.

Time: Six 40-minute sessions.

Procedure:

The teacher guides the investigation: presents the challenge, asks questions, and leads brainstorming sessions about chemical compounds. Groups are formed, and roles are assigned (facilitator, recorder, designer, presenter). The rubric and activity schedule are presented. Digital resources are provided, and the teacher models information searches: how to read labels, record data, and ethical considerations (consent for taking photos at home). Students investigate organic and inorganic chemical compounds in everyday objects. Students collect evidence at home (photos, labels), complete the worksheet, and in class create a presentation, which can be a video, PowerPoint, interactive game, brochure, or written presentation. Throughout the process, the teacher acts as an advisor, reviews progress, and offers support. The groups present and explain their product at the project fair. The teacher evaluates and provides feedback.

Evaluation: Rubric with criteria for research, presentation, and teamwork (self-evaluation and peer evaluation).

Activity 6. Science Lottery of Matter.

Skill: CN.3.3.2 and CN.3.3.3

Objective: To reinforce learning about the types of matter, atoms, and mixtures through an inclusive, playful activity.

Resources: Personalized play tickets, game pieces, projector, descriptive audio.

Time: 40 minutes.

Procedure:

The teacher explains the activity. Distribute the cards with specific adaptations (large text, images, QR codes with audio) and explain the rules of the game. Describe each square using different formats and textual descriptions, and pose additional challenges in special squares, for example: explain in 30 seconds why it is a mixture. Provide reference cards for those who need support. The student draws a lottery ticket and marks the squares as they recognize examples or concepts related to matter, atoms, and mixtures. They must also justify their moves when requested. Students can change a square if they provide a scientific justification. Symbolic prizes and points are awarded for correct explanations. The teacher clarifies errors and reinforces concepts.

Evaluation: Observation of participation, understanding of concepts, and final self-evaluation.

Activity 7. The Force Race.

Skill: CN.3.3.6

Objective: To explore the effects of different types of forces on the motion of objects, identifying how they change their shape, speed, or direction.

Resources: Toy cars, rubber balls, balloons, ramps, stopwatches, measuring tape, recording sheets, digital whiteboard or projector.

Time: 80 minutes.

Procedure:

The teacher begins with a brief demonstration: dropping a ball and asking, "What forces are involved?" They explain the objective of the activity and present the game dynamics, in which teams compete to discover how forces alter the motion of objects. The teacher shows a short video about types of forces (push, friction, gravity) with subtitles and adapted language (UDL). The students organize themselves into groups of four and receive a guide with three experimental challenges: Speed challenge: launching a toy car from different ramp heights and measuring the travel time. Shape Challenge: Compress a balloon or sponge with different

weights and observe the change. Direction Challenge: Make two balls collide and record how their trajectories change. The teacher circulates among the groups, asks questions, and assists those who require visual or sensory support. Each team earns stars for the accuracy of their observations, collaboration, and oral explanation of the phenomenon. They communicate their conclusions orally or through a drawing or short recording (UDL: Multiple Expression). The teacher systematizes the results and reinforces the concepts of force, motion, and change of shape.

Evaluation: Rubric with observation criteria (active participation, teamwork, clarity in explaining the effects of forces). Both the experimental process and the final reflection are considered.

Activity 8. The Journey of Electrical Energy.

Skill: CN.3.3.11

Objective: To analyze the transformations of electrical energy from its generation in a hydroelectric plant to its conversion into other forms of energy.

Resources: Computers or tablets with internet access, educational video about Ecuadorian hydroelectric plants, recycled materials, whiteboard, worksheets.

Time: 80 minutes.

Procedure:

The teacher presents the challenge: the journey of energy, using an interactive video about the Paute Dam, highlighting the water's path and the generation of electricity. The teacher explains that each group must build a model or digital diagram representing the energy transformations. The students, organized into cooperative groups, work at different stations: Station 1. Generation: They analyze how the movement of water is converted into electrical energy. Station 2. Transmission: They represent how energy travels through cables and poles. Station 3. Transformation: They experiment with simple circuits to observe how electrical energy is transformed into light (light bulb), movement (motor), sound (speaker), and heat (resistor). The teacher provides adapted support materials (visual diagrams, explanatory audio, expanded text) to ensure accessibility. Groups earn points for creativity, accuracy, and cooperation in developing their presentation. Each team presents its model or digital infographic. The teacher leads a guided discussion on the importance of responsible energy use and awards a symbolic badge to each group.

Evaluation: A rubric assesses understanding of energy transformations, use of scientific language, and cooperation.

Activity 9. Magnetism in Action.

Skill: CN.3.3.12

Objective: To describe the characteristics of magnetism and its application in everyday life.

Resources: Magnets, simple compasses, paper clips, pins, pieces of metal, small toy motors, tablets or cell phones with a digital compass, notepads, projector.

Time: 80 minutes.

Procedure:

The teacher begins the class with a challenging question: Why does the compass always point north? The teacher takes out a compass and an electric motor and invites the students to formulate hypotheses. The objective of the lesson is presented, and the students are organized into teams for the activity. Each group has three missions: 1. Compass: Use a physical compass and a digital compass to find north. Then compare the results. 2. Attraction: Test which objects stick to the magnet and record everything. 3. Motor: Connect a small motor to a battery, observe how it moves, and explain the role of magnetism in all of this. The teacher guides the activity, provides visual and auditory support (UDL), and asks questions that encourage scientific thinking. Teams earn points for recording accurate observations, cooperating, and correctly justifying the phenomena. In the second session, each group presents its results: this can be a drawing, a presentation, an audio recording, or a video. The teacher concludes the activity by reinforcing the importance of magnetism in everyday life.

Evaluation: A rubric is used to assess the experiment, the clarity of the explanations, and teamwork. Peer evaluation also takes place between groups.

Activity 10. The Energy That Moves Us.

Skills: CN.3.3.6, CN.3.3.11, and CN.3.3.12

Objective: To integrate knowledge about force, energy, and magnetism through the collaborative development of a practical project that demonstrates an energy transformation.

Resources: Recycled materials, simple tools, computer or tablet for documentation, camera or cell phone, digital whiteboard. Time: Four 40-minute sessions.

Procedure:

Session 1. Inquiry and Planning: The teacher presents the challenge: to design a prototype that demonstrates how energy is transformed or used to produce movement, light, or sound. The teacher explains the project criteria and the evaluation rubric. Students form groups of 4 or 5 and generate ideas (for example, a motorized car, a homemade compass, a lamp with a simple circuit). Each group develops its work plan and materials list.

Session 2. Guidance and Follow-up: The teacher guides the work stages, offers differentiated support (guide videos, diagrams, simplified instructions), and encourages peer collaboration.

Session 3. Construction and Experimentation: The groups build their prototypes and document the process using photographs or videos (Universal Design for Learning). During the session, mini-games are included (each group earns an energy piece for achieving partial objectives such as connecting the circuit or achieving movement).

Session 4. Presentation and Sharing: The teams present their prototypes at a school science fair. They explain how force, energy, and magnetism are involved in its operation. They can use models, digital presentations, or dramatizations. The teacher guides the presentations and facilitates peer review.

Evaluation: a comprehensive rubric that assesses scientific understanding, inquiry process and collaborative work, originality and functionality of the prototype, and oral or visual communication of the project. A self-evaluation of learning and group collaboration is included.

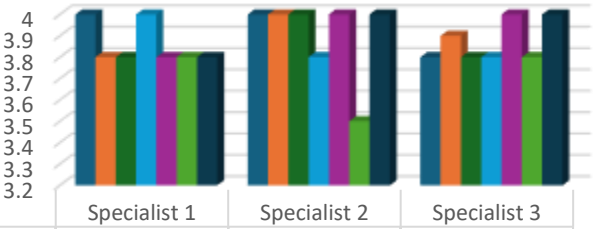
Stage 3. Implementation and Evaluation of the Proposed Activities.

In this stage, the pedagogical relevance and feasibility of the gamified learning activities designed to improve the teaching and learning process of the Matter and Energy curriculum block within the Natural Sciences subject for sixth-grade students at the Zoilo Rodríguez Educational Unit in Loja Province are evaluated. This evaluation is conducted using expert judgment, which unfolds through three sequential phases.

In the first phase, the specialists are selected based on pre-established criteria, such as professional experience, academic level, theoretical and practical knowledge of matter and energy, and Natural Science didactics, as well as professional ethics and willingness to participate in this process. The study population consisted of seven specialists, from whom a sample of three was selected. All three had over 10 years of experience as teachers in Ecuadorian basic education; two held master's degrees in Basic Education and one held a PhD in

Pedagogical Sciences, with a background in Chemistry. In the second phase, the specialists were given the proposal and the instruments for evaluating the pedagogical relevance and feasibility of the gamified learning activities. In the third phase, the results obtained from the applied instruments were processed, the specialists' observations were analyzed, and the necessary adjustments were made based on the strengths and weaknesses they identified. A final report was prepared presenting the qualitative and quantitative results of the evaluation process, highlighting positive aspects, areas for improvement, and making recommendations. The assessment issued by the specialists confirms the validity and pedagogical relevance of the gamification-based activities, as shown in Figure 3.

Figure 3. Validation of the proposed activities



	Specialist 1	Specialist 2	Specialist 3
Relevance to the national curriculum.	4	4	3.8
Internal coherence.	3.8	4	3.9
Clarity of instructions.	3.8	4	3.8
Scientific rigor of content.	4	3.8	3.8
Feasibility in rural contexts.	3.8	4	4
Innovation and didactic relevance.	3.8	3.5	3.8
Relevance: responds to the students' reality.	3.8	4	4

Source: Authors' own elaboration.

Based on the evaluation results and considering the specialists' observations, it is concluded that the proposed gamification-based activities for teaching the Matter and Energy unit in sixth grade are relevant, coherent, and feasible within the educational context. Among the main strengths identified by the specialists are: the alignment of the activities with the national curriculum, ensuring coherence between skills, objectives, and assessment criteria; they also highlight the variety of activities that promote meaningful learning through gamification and student experience. Another positive aspect is that the activities are inclusive and contextualized, which improves student motivation and engagement in their own learning. The specialists identified weaknesses that need to be addressed, the first being the teachers' lack of preparation

for systematically implementing gamification, which could affect the proper application of the proposed activities. Furthermore, they point out the gap that exists in rural contexts regarding access to technological resources and the internet, which may limit the implementation of some of the activities.

They recommend strengthening teacher training processes in active methodologies, especially gamification, cooperative learning, and the use of technological resources, so that they can creatively adapt and apply the proposed activities.

In summary, the activities evaluated by specialists have high curricular relevance, methodological coherence, and feasibility; making it an innovative and applicable proposal to improve the teaching and learning process of Natural Sciences in sixth grade from a playful, participatory, and inclusive approach.

Conclusions

The systematization of the theoretical frameworks confirmed that gamification is an effective didactic tool for improving the teaching and learning process of Natural Sciences. From a constructivist perspective, it was evident that elements of play, cooperation, and experience are essential for sparking student interest, scientific curiosity, and active participation, especially in abstract topics such as those covered in the Matter and Energy unit.

The diagnostic assessment revealed difficulties in the teaching and learning process of Natural Sciences that limit students' active participation in learning the Matter and Energy curriculum unit. This is attributed primarily to the limited use of active methodologies and strategies that connect the content to everyday life. Furthermore, gamification is not used systematically in class, which limits student engagement and commitment to learning this content.

The gamification-based teaching activities proposed to improve the teaching and learning process of the Matter and Energy curriculum unit were assessed by specialists as relevant, coherent, and feasible because they respond to the real needs of the educational context, align with the national curriculum, and promote inclusive and meaningful learning. Expert evaluation confirmed that the proposal is an innovative and applicable tool for revitalizing the teaching of Natural Sciences, promoting student motivation and active participation.

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