Recibido: *25/10/2025* ***Aceptado:*** *15/03/2026*

Digital tools for learning Natural Sciences in the seventh year of Basic Education (Original)

Herramientas digitales para el aprendizaje de las Ciencias Naturales en séptimo año de Educación Básica (Original)

María del Carmen Cuesta Pillaga. *Licenciada en Ciencias de Educación Básica. Docente en Educación General Básica. Unidad Educativa Shungumarca. Ecuador.*
[marylini@hotmail.com] [https://orcid.org/0009-0009-8371-8555]

Willian Oswaldo Garcia Bermello. *Licenciado en Teología. Ecuador.*
[williamgarcia1989@gmail.com] [https://orcid.org/0009-0003-2014-8555]

Roelbis Lafita Frómeta. *Lic. en Educación. Biología. Doctor en Ciencias Pedagógicas. Profesor Titular. Universidad Metropolitana del Ecuador.* [rosyroe2@gmail.com]
[https://orcid.org/0000-0003-1396-1073]

Elizabeth Esther Vergel Parejo. *Doctor en Educación. Docente investigador de la Universidad Bolivariana del Ecuador. Durán. Ecuador.* [eevergelp@ube.edu.ec]
[https://orcid.org/0009-0007-0178-5099]

Abstract

This research stemmed from the need to improve the teaching and learning process of Natural Sciences, given the limited use of digital tools, the scarce application of active methodologies, and the persistence of traditional practices focused on memorization. These factors hindered the construction of meaningful learning and the development of scientific thinking in seventh-grade students. To address this problem, a didactic proposal was designed based on the pedagogical use of digital tools, integrating innovative methodologies and grounded in the principles of meaningful learning and universal design for learning. The research followed a mixed-methods approach, descriptive, non-experimental, and field-based, allowing for the combination of quantitative and qualitative techniques for the processing, analysis, and evaluation of the proposal. The results of the expert evaluation confirmed the pedagogical relevance, curricular coherence, scientific rigor, and feasibility of implementing the proposed didactic strategies. It was concluded that the implementation of these strategies promotes active student participation, the understanding of natural phenomena, and the development of meaningful learning through the pedagogical use of digital tools.

Keywords: digital tools; learning; Natural Sciences; teaching strategies

Resumen

La investigación se desarrolló a partir de la necesidad de mejorar el proceso de enseñanza aprendizaje de las Ciencias Naturales, ante la limitada utilización de herramientas digitales, la escasa aplicación de metodologías activas y la persistencia de prácticas tradicionales centrada en la memorización; lo que dificultaba la construcción de aprendizaje significativos y el desarrollo de pensamiento científico en los estudiantes de séptimo año de básica. Con el propósito de atender esta problemática, se diseñó una propuesta didáctica basada en el uso pedagógico de las herramientas digitales que integran metodologías innovadoras, sustentada en los principios de aprendizaje significativo y el diseño universal para el aprendizaje. La investigación siguió un enfoque polimodal o mixto, de tipo descriptivo, no experimental y de campo, lo que permitió combinar técnicas cuantitativas y cualitativas para el procesamiento, análisis y valoración de la propuesta. Los resultados de la valoración por criterio de especialistas confirmaron la pertinencia pedagógica, coherencia curricular, carácter científico y viabilidad de aplicación de las estrategias didácticas propuestas. Se concluyó que la implementación de estas estrategias favorece la participación activa del estudiante, la comprensión de fenómenos naturales y el desarrollo de aprendizajes significativos mediados por el uso pedagógico de las herramientas digitales.

Palabras clave: herramientas digitales; aprendizaje; Ciencias Naturales; estrategias didácticas

Introduction

Technology has significantly transformed contemporary educational processes, becoming a fundamental resource for pedagogical innovation and the improvement of the teaching and learning process. Currently, technological resources not only facilitate information management and communication but also promote the active construction of knowledge through interactive, collaborative, and contextualized experiences.

This study is based on learning theories that recognize the active role of the student and the construction of knowledge. Vygotsky (1979) proposed that learning occurs in a social context through interaction with others, highlighting the importance of cultural mediation and language as tools for cognitive development. In this sense, digital tools can be considered contemporary cultural mediators that expand the zone of proximal development by allowing students to learn with the support of technological tools and collaboration with their peers and teachers. Piaget & Inhelder (2008), for their part, maintained that learning is a constructive process in which the individual actively organizes and structures their knowledge through assimilation and accommodation. In the teaching of Natural Sciences, digital tools facilitate learning experiences that stimulate logical thinking and problem-solving, promoting the transition between stages of cognitive development through virtual manipulation and autonomous exploration of content. Ausubel (1983) argued that new knowledge is substantively integrated into the student's cognitive structure when it is related to prior knowledge and has personal meaning. Digital tools in the teaching and learning process of Natural Sciences act as facilitators of the connection between prior and new knowledge because they offer visual representations, simulations, and interactive experiences that stimulate the understanding and retention of scientific knowledge.

The use of technological resources for educational purposes has been extensively studied by authors such as Salinas & De-Benito (2020), who argue that the integration of information and communication technologies (ICTs) in education fosters student participation as the protagonist of their own learning, allowing them to develop cognitive, social, and digital skills in accordance with the demands of the knowledge society. Castro & Alanya (2024) conducted a study highlighting the potential of ICTs in interactive and dynamic learning, as well as the need to adapt the curriculum to current demands. They emphasized the urgency of developing digital skills and collaborative strategies to address the challenges of online education. According to these authors, this new scenario encourages teachers to rethink their methodologies and incorporate digital tools that enhance motivation, innovation, and the understanding of curricular content.

In the case of Natural Sciences, the use of technological resources acquires particular relevance, enabling the observation of natural phenomena, virtual experimentation, and the simulation of processes that are complex or inaccessible in the traditional classroom. Several studies highlight that technology allows for the visual and dynamic representation of scientific concepts, facilitating the understanding of abstract notions and promoting meaningful learning.

This is the case, for example, of Viñan & Montoya (2023), who conducted a study to analyze the influence of ICTs on the learning of Natural Sciences by sixth-grade students; concluding that the use of ICTs significantly improves the learning of Natural Sciences in this group of students. Furthermore, Coello (2023) analyzed how Google Classroom, an online educational platform, influences the learning of Natural Sciences in ninth-grade students. He conducted a quasi-experimental study that included a control group, allowing for a comparison of results between students who used Google Classroom and those who followed a traditional teaching approach.

The results revealed that the experimental group using Google Classroom obtained significantly higher grades compared to the control group that followed the traditional teaching method. The statistical analysis supported the hypothesis that the effective integration of digital tools in the teaching of Natural Sciences has a positive impact on the understanding of scientific concepts and on student motivation.

Alcívar & Bowen (2024), designed a methodological proposal using Educaplay for teaching Natural Sciences to fourth-grade students. The results demonstrated that Educaplay develops interactive activities that promote student participation, making learning more dynamic and engaging. This allowed them to conclude that the application of Educaplay had a positive effect on the teaching of Natural Sciences, given the significant difference in correct answers compared to those of a traditional explanation. This research corroborates the need to integrate technological tools into the teaching of Natural Sciences as an effective means to promote meaningful learning in seventh-grade students. The studies analyzed agree that the pedagogical use of ICT strengthens conceptual understanding, motivation, and active student participation. They also highlight that the incorporation of technology must be accompanied by adequate teacher training and intentional lesson planning capable of linking scientific content with practical experiences and real-world contexts.

The Ministerio de Educación del Ecuador (2023) has promoted policies aimed at strengthening teachers' technological skills and the pedagogical use of ICTs, recognizing their potential to improve educational quality and foster scientific literacy. However, in the Ecuadorian context, challenges persist that limit the integration of technological resources into teaching practice, related to infrastructure, teacher training, and equitable access. Furthermore, the effectiveness of these resources depends on their integration with appropriate teaching strategies that respond to the characteristics, interests, and contexts of the students.

At the Shungumarca Educational Unit in the General Morales parish of the Cañar canton, seventh-grade students have difficulty understanding fundamental scientific concepts and show little motivation toward learning this subject. Among the main causes of this situation is the limited use of the potential offered by digital tools in the teaching and learning process. Although the institution has certain resources and internet access, its pedagogical use is still in its infancy and is often limited to information searches or static presentations, without taking advantage of its didactic value for virtual experimentation, simulation of natural phenomena, or interactive learning. This is compounded by factors such as insufficient teacher training in the use of information and communication technologies, a lack of innovative methodological strategies, and the persistence of traditional models focused on memorization. The combination of these factors limits the development of scientific and critical thinking in seventh-grade students, hindering the development of meaningful learning. Therefore, the research problem of this study is: How to contribute to the development of meaningful learning in seventh-grade students in the subject of Natural Sciences at the Shungumarca Educational Unit, located in the General Morales parish of the Cañar canton?

To address this problem, the research objective is established as: To propose didactic strategies based on the pedagogical use of digital tools that promote the development of meaningful learning in seventh-grade students in the subject of Natural Sciences, at Shungumarca Educational Unit, in the Cañar canton.

Materials and Methods

The research follows a mixed-methods approach (qualitative-quantitative), which allows the authors to delve deeper into the problem identified at the Shungumarca Educational Unit in relation to the learning of seventh-grade students in the subject of Natural Sciences. The research is descriptive, non-experimental, and field-based, because it studies the scientific phenomenon in its natural environment, obtaining data directly from seventh-grade teachers and students about the learning process of Natural Sciences, without manipulating or controlling the variables.

This research employs a variety of scientific methods, ensuring the rigor and coherence of the investigative process. Among the theoretical methods used is analysis-synthesis, which allows the authors to thoroughly examine the learning process in Natural Sciences through the review, comparison, and systematization of existing theoretical frameworks. This facilitates the understanding of the relationships between the concepts, principles, and pedagogical approaches that underpin the teaching and learning process in this area of knowledge, leading to the construction of a solid theoretical framework. Furthermore, the inductive-deductive method is applied during the diagnostic phase, allowing for the collection of information from concrete facts and experiences related to the use of digital tools in the teaching and learning process of

Natural Sciences. To establish generalizations, general theoretical principles are used to interpret and explain the phenomenon under investigation.

At the empirical level, the following methods are used: observation, surveys, and interviews, which guarantee a direct approach to educational reality. Through observation, the authors can systematically identify classroom dynamics, the pedagogical strategies employed, and the level of student participation during classes. The interview facilitates obtaining qualitative information from the teachers' perspective, providing a deeper understanding of their practices, perceptions, and limitations in the use of digital tools. The survey, on the other hand, allows for obtaining quantifiable information about the experiences, attitudes, and difficulties faced by seventh-grade students in the subject. Furthermore, statistical mathematical methods are used for processing the quantitative information, interpreting, and tabulating the data obtained. To assess the relevance of the proposal, the expert judgment method is used.

The research was conducted at the Shungumarca Educational Unit, located in the General Morales parish of the Cañar canton, Cañar province, which belongs to Zone 6. It is a rural educational center offering in-person instruction in both morning and evening sessions. The study population consisted of the 61 seventh-grade students and the three teachers who teach Natural Sciences. Due to the authors' interest, a purposive sample of 31 students from section A was selected to analyze the research topic in depth, while the three teachers remained involved.

The methodological approach used in the research was developed in three stages: the first was the initial diagnostic phase; the second involved designing didactic strategies based on the pedagogical use of digital tools; and the third stage consisted of the application and evaluation of the proposed approach.

Stage 1: Initial Diagnosis.

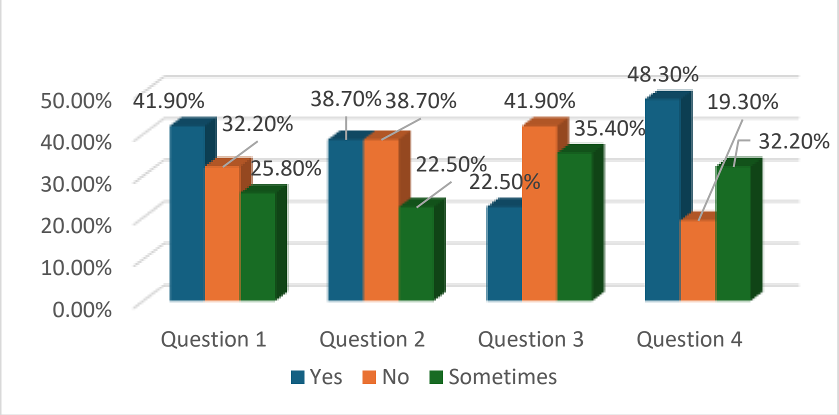
During the diagnostic phase, various research techniques were used to gather information that would characterize the current state of seventh-grade students in relation to learning Natural Sciences at Shungumarca Educational Unit. The survey, administered to seventh-grade students, consisted of an eight-question closed-ended questionnaire. Interviews were conducted with the three teachers who teach the subject. Participant observation was also carried out using an observation guide to obtain qualitative information on the use of digital tools in the teaching and learning process of Natural Sciences.

Analysis and discussion of the results

The results of the first four questions reveal different perceptions among the students regarding their preferences and understanding of Natural Sciences (see Figure 1). In response to the first question, 42% of the students stated that they enjoyed learning the subject, while 32% indicated that they did not, and the remaining 26% only sometimes enjoyed learning about Natural Sciences. These data reveal a moderate level of motivation towards the subject, possibly influenced by the teaching methodology or the limited use of technological resources. In response to the second question, 39% of the students surveyed found the classes interesting and easy to understand, the same percentage (39%) perceived them as difficult, and 22% considered Natural Science classes only sometimes interesting and easy to understand. This suggests an urgent need to rethink the teaching strategies used in class, as more than half of the surveyed group does not find Natural Sciences sufficiently engaging or understandable.

Regarding the use of technological resources, the results are less encouraging; only 23% of the students indicated that the teacher frequently uses digital tools, while 42% responded that they never do, and 35% stated that technological tools are only sometimes used in the classroom. This trend can be explained by the students' responses to question two, which revealed a low level of understanding and motivation for the subject. In question four, 48% of the students acknowledged that the use of technological resources helps them better understand Natural Science topics, compared to 19% who felt it was not helpful. This indicates a positive assessment by the students regarding the use of digital tools in their learning; however, the data above confirm that their integration into Natural Science classes is still insufficient and requires more intentional lesson planning to generate meaningful learning.

Figure 1. Quantitative results of questions 1, 2, 3 and 4



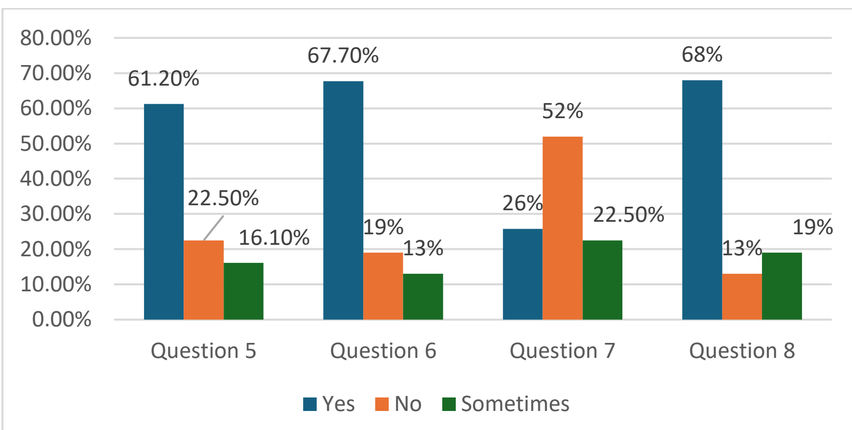
Source: Own elaboration.

The results of the last four questions reflect a contrast between the availability of technological resources and their pedagogical use, as shown in Figure 2. For example, in question 5, 61% of students reported having access to digital devices, while 23% indicated they did not, and 16% said they only had access to these resources occasionally. This demonstrates that most students have technological resources at home or in their surroundings.

In question 6, 68% believe that the school has sufficient technological resources, while 13% doubt their sufficiency. This availability does not guarantee the effective pedagogical use of these resources, and this is corroborated in question 7, where 52% of students stated that teachers do not teach them how to use digital tools to learn Natural Sciences, compared to 26% who said they do, and 23% who said they only do so sometimes.

This result reveals a training gap among teachers regarding the use of digital tools. In the final question, 68% of the students surveyed acknowledged that the use of digital tools makes classes more dynamic and motivating, while only 13% disagreed. In short, students value the impact of digital tools on their learning, but the data confirms that their integration into the teaching and learning process of Matter and Energy topics is still insufficient and requires more intentional lesson planning to generate meaningful learning.

Figure 2. Quantitative results of questions 5, 6, 7 and 8



Source: Own elaboration.

These results indicate that technological resources cannot be viewed solely as technical instruments, but rather as pedagogical resources that, when properly integrated, enhance students' cognitive processes, critical thinking, and creativity. (Rey & Vergara (2025), urge educational institutions to utilize digital learning processes that foster students' critical thinking, implying a shift from traditional pedagogical approaches. In the case of teaching and learning

Natural Sciences, digital tools enable the exploration of phenomena that, due to their complexity or inaccessibility, are difficult to address in physical environments. From the perspective of Espinoza (2023), digital resources in Natural Sciences encompass a wide range of tools, including simulators, interactive applications, educational videos, and online learning platforms.

The teaching of Natural Sciences in seventh grade is characterized by the need to cater to a group of students in full transition to formal thought, who demonstrate a natural curiosity about their environment and an interest in scientific phenomena, but who require active methodologies that promote their participation. In educational practice, it is observed that the teaching process, in many cases, focuses on the transmission of content and memorization, which limits the possibility of developing critical and scientific thinking in students. The lack of use of digital tools restricts the creation of more dynamic, interactive, and contextualized learning experiences. According to information obtained from interviewed teachers and observations made, the predominant strategies in the classroom are lectures, reproduction exercises, and basic experiments; although these allow for some learning, they are insufficient to foster meaningful learning. The absence of active methodologies such as gamification, cooperative and collaborative learning, or the use of digital tools reduces opportunities for students to actively construct knowledge.

The integration of digital tools into science education is limited and, in most cases, is reduced to the use of audiovisual resources and presentations. Although these tools help capture students' attention and facilitate the visual understanding of certain natural processes, their application lacks a structured pedagogical approach. According to teachers, the training they receive for the pedagogical use of technology is insufficient, preventing them from leveraging its potential to foster meaningful learning, experimentation, and the application of knowledge in virtual contexts.

Another difficulty teachers face when incorporating digital tools into matter and energy classes is the lack of adequate infrastructure and the insufficient time to plan innovative activities. Added to this is an implicit resistance to methodological change, stemming from the persistence of traditional teaching models. These conditions hinder the effective implementation of strategies that promote the use of digital tools and impede the development of scientific competencies in students. This information indicates that it is necessary to strengthen the processes of continuous teacher training oriented towards the didactic use of digital tools, prioritizing practical training contextualized to the national curriculum and fostering spaces for collaboration among teachers for the exchange of successful experiences, as well as promoting institutional policies that encourage educational innovation.

Stage 2: Design of teaching strategies based on the pedagogical use of technological resources in Natural Sciences.

Technological resources in education encompass both hardware and software, from physical equipment (computers, tablets, projectors) to virtual platforms, interactive applications, and digital learning environments (Madrigal et al., 2025). Their value lies in their ability to diversify teaching methods, promote active student participation, and generate more dynamic, contextualized, and meaningful learning experiences. Digital tools, as part of these resources, facilitate the acquisition, processing, and communication of information, becoming essential mediators of learning in the current educational context. They are specific applications or programs that enable the development of interactive, creative, and collaborative pedagogical activities. According to Romo et al. (2023), digital tools allow for the transformation of traditional learning environments into dynamic, participatory, and student-centered spaces through the integration of multimedia resources and active learning strategies. Examples of these applications include Kahoot, Genially, Quizizz, and Canva, which enhance knowledge construction.

These represent the operational component of technological resources, as they are the concrete instruments that teachers use to design more active and contextualized learning experiences. Their use in the teaching of Natural Sciences becomes an effective means of linking curricular content with the digital and scientific competencies demanded by today's society, provided it is based on a didactic plan. Teaching this area aims to promote students' understanding of physical, chemical, and biological phenomena and processes, as well as the development of critical thinking, inquiry skills, and attitudes of respect for the world around them.

The teaching strategies designed for seventh year of Basic General Education for Natural Sciences are aligned with the skills of the Ecuadorian curriculum and integrate digital tools, active methodologies and respond to principles of inclusion and accessibility, in accordance with the Universal Design for Learning (UDL) approach.

Strategy 1. Discovering the World of Invertebrates.

Skill: CN.3.1.1. Investigate, using ICT and other resources, the characteristics of invertebrate animals, describe them, and classify them according to their similarities and differences.

Objective: To classify the main groups of invertebrate animals through interactive exploration and the collaborative creation of a digital mural.

Resources: Computer or tablet with internet connection, digital tool: Padlet or Genially. Educational videos (YouTube EDU) and free image banks (Pixabay, Unsplash).

Time: 2 sessions of 40 minutes.

Procedure:

The teacher introduces the topic with a video. Then, they lead a brainstorming session about invertebrate animals. The students, working in cooperative groups, research online the characteristics and examples of different groups of invertebrates. The teacher creates a Padlet and chooses a format: wall, columns, or whiteboard. The teacher shares the link or QR code with the students.

The students click the "More" button to publish and, using the information gathered, create a digital mural on Padlet (columns for classifying invertebrates, and they post photos with brief explanations on the mural). Finally, each group presents their mural and reflects on biodiversity and the ecological role of invertebrates.

Evaluation: A rubric is used to assess the correct classification of the animals, the digital presentation, cooperative work, and the ability to communicate information clearly and visually.

Strategy 2. The Green Lab: We Experiment with Photosynthesis.

Skill: CN.3.1.3. Experiment on photosynthesis, nutrition, and respiration in plants, explain them, and deduce their importance for the maintenance of life.

Objective: To understand the process of photosynthesis through experimentation and the use of interactive digital simulators.

Resources: Jars with leaves, water, sunlight, vinegar, and baking soda (for the experiment). Digital tool: PhET Interactive Simulations. Cell phone camera for recording evidence.

Time: Two 40-minute sessions.

Procedure:

The teacher poses the guiding question: What does a plant need to live?

In small groups, students conduct a simple experiment on the release of oxygen from submerged leaves. Then, they access the PhET simulator to observe the complete process of photosynthesis. During the simulation, they can take screenshots and record which variables they changed and what they observed. Each group creates a short video or digital presentation explaining their observations. The conclusions are shared, and reflection on the importance of plants for life on Earth is encouraged.

Evaluation: Participation in the experiment, conceptual understanding, scientific argumentation, and responsible use of ICT will be assessed.

Strategy 3. Getting to Know Our Bodies: The Human Reproductive System

Skill: CN.3.2.1. Investigate and describe the structure and function of the human reproductive system, both female and male, and explain its importance in the transmission of hereditary characteristics.

Objective: To recognize the structures and functions of the human reproductive system and its role in genetic inheritance through interactive activities.

Resources: Computer, digital whiteboard or tablets. Digital tools: Kahoot! and BodyMap.org. Graphic materials and interactive worksheets.

Time: 2 sessions of 40 minutes each.

Procedure:

The teacher begins with a brief discussion about the importance of respect and comprehensive sexuality education. Students access the website and choose the system to explore. They observe interactive models of the human body on BodyMap.org (an interactive body map with basic anatomical views). They watch the video and they note three findings and also write down one interesting fact. Find two structures of the reproductive system and explain their function in 20 words each. At the end, the groups will create a digital comparative diagram of the male and female reproductive systems.

Evaluation: Performance in the game, understanding of the functions, and appropriate use of scientific and respectful language will be assessed.

Strategy 4. The Journey Through the Human Body.

Skill: CN.3.2.3. Describe, with the support of models, the structure and function of the digestive, respiratory, circulatory, and excretory systems and promote their care.

Objective: To identify the functions and interrelationships of the main systems of the human body through the exploration of three-dimensional models.

Resources: Tablets or computers. Digital tool: Anatomy Learning 3D or shared digital notebook on Google Docs.

Time: 2 sessions of 40 minutes each.

Procedure:

The teacher divides the class into groups, assigning a body system to each group. Students explore 3D models to observe organs, pathways, and functions. In a shared notebook, each group creates a summary with images and explanations about how their system relates to the others. Finally, a rotating presentation takes place: each group teaches the others what they have learned.

Evaluation: Scientific accuracy, collaboration, and clarity of presentation are assessed. Appropriate use of ICT and participative attitude will also be considered.

Strategy 5: The Virtual Atom Challenge

Skill: CN.3.3.2

Objective: To understand the structure of the atom and its main components through a gamified and interactive environment.

Resources: Computers or tablets, internet connection, PhET simulator: Build an atom, worksheets, projector.

Time: 2 sessions of 40 minutes each. Procedure:

The teacher presents the didactic model of the atom through a short video and guides the use of the PhET simulator. The teacher forms teams of 4 students and assigns roles (moderator, recorder, simulator operator, timekeeper). They propose a game in which each group must build different assigned atoms (for example, helium, oxygen, or nitrogen) and explain their characteristics. Working in cooperative groups, they carry out the activity: the operator manipulates the simulator; the recorder notes observations; the moderator coordinates timing.

The teacher asks questions of varying levels (Why does the net charge change if you remove electrons? What properties will the atom have?) and the evidence is recorded. Teams earn points for each correct answer. The teacher offers different alternatives for completing the activity (text, concept map, audio recording) for Universal Design for Learning (UDL).

Assessment: Checklist to verify understanding of atomic structure and participation in cooperative work.

Strategy 6: Element Seekers.

Skill: CN.3.3.2

Objective: To identify chemical elements through a collaborative search game.

Resources: Cards with chemical symbols, posters, colored pencils, mobile devices with QR code readers.

Time: 2 sessions of 40 minutes each.

Procedure:

The teacher explains the search activity, shows an example of a card, and demonstrates how to use a QR code reader (step-by-step instructions with images).

The teacher forms teams of 4 students and assigns roles. They provide clues and hide cards around the classroom/nearby areas with varying levels of difficulty. On the platform (or shared document), each QR code reveals: a symbol, an interesting fact, and a mini-challenge (e.g., relating it to everyday use). The teacher provides support flags: cards with pictograms for students who require visual access. The teacher supervises and facilitates the activity.

Teams rotate through stations: some locate the cards, others scan QR codes and complete the record on the template (name, symbol, atomic number, use). Students rotate between rounds. Virtual medals are awarded for speed, accuracy, and creative explanation. Teams have "wildcard" cards that allow them to ask the teacher for a hint if needed (promoting metacognition).

Evaluation: Record of participation and accuracy in identifying the chemical elements.

Strategy 7. Escape Room of the States of Matter.

Skill: CN.3.3.3

Objective: To recognize the physical states of matter and their changes through a digital escape room game.

Resources: Genially or Wordwall platform, computers, projector, clue cards.

Time: 2 sessions of 40 minutes.

Procedure:

The teacher designs a virtual escape room with puzzles about the solid, liquid, and gaseous states. Explain the rules and organize the students into teams. The students solve challenges to escape the laboratory, applying their knowledge. Each correct clue unlocks a part of the exit door.

Assessment: Record of correct answers and observation of cooperative work and decision-making.

Strategy 8. Kahoot on Compounds.

Skill: CN.3.3.4

Objective: To interactively assess understanding of organic and inorganic chemical compounds.

Resources: Kahoot platform, projector, mobile devices.

Time: 2 sessions of 40 minutes.

Procedure:

The teacher prepares a Kahoot quiz about the chemical compounds studied. Students participate individually or cooperatively, answering the questions and reflecting on their answers at the end.

Assessment: Automatic game results and group discussion on successes and difficulties.

Strategy 9. Navigating the Solar System.

Skill: CN.3.4.3. Investigate, using ICT and other resources, the solar system, describe some of its components, use simulation models, and explain lunar and solar eclipses.

Objective: To understand the structure of the solar system and astronomical phenomena through the use of digital simulators.

Resources: Computer or tablet. Digital tool: Solar SystemScope or NASA Eyes. Interactive whiteboard or projector.

Time: 2 sessions of 40 minutes each.

Procedure:

The teacher poses the initial question: Why do eclipses occur?

The students explore the Solar SystemScope simulator to observe the orbits and sizes of the planets.The teacher leads a guided activity to identify the cause of eclipses and the relative positions of the Sun, Earth, and Moon.

Each group creates a digital presentation with images from the simulator to explain their understanding. Evaluation: Conceptual accuracy, quality of digital explanation, and participation in exploration will be considered.

Strategy 10. When the Earth Gets Angry.

Skill: CN.3.4.14. Investigate and infer the characteristics and effects of climate disasters and establish the consequences for living beings and their habitats.

Objective: Analyze the causes and consequences of climate disasters through case studies and the use of digital simulation tools.

Resources: Computers or tablets. Digital tools: Google Earth and EarthquakesTracker. UN infographics and educational videos.

Time: 2 sessions of 40 minutes each.

Procedure:

The teacher presents images and videos about different types of natural disasters. Students investigate a specific type of disaster (hurricanes, droughts, earthquakes, among others) in groups, using Google Earth to locate affected areas. Each group creates a digital infographic in Canva with information about causes, consequences, and preventive measures. A collaborative presentation is held in a science fair format.

Evaluation: The scientific quality of the information, the creativity of the infographic, teamwork, and reflection on environmental responsibility will be assessed.

The designed teaching strategies constitute an innovative and contextualized proposal to strengthen meaningful learning for seventh-grade students in Natural Sciences, through the pedagogical use of digital tools that promote active participation, inquiry, collaborative work, and the inclusion of all students. Once the proposal is designed, it is essential to subject it to a validation process to verify its relevance, coherence, and applicability in the Ecuadorian educational context, ensuring that it effectively responds to the needs and characteristics of the students.

Stage 3: Application and validation of the proposal.

The proposal is evaluated using expert criteria, with the objective of assessing its relevance, internal coherence, and feasibility of the proposed teaching strategies based on the pedagogical use of digital tools in Natural Sciences for seventh grade of basic education.

In the first stage, specialists are selected based on pre-established criteria, such as professional experience, academic level, proficiency in the use of digital tools, knowledge of active and inclusive methodologies, solid knowledge of Natural Science didactics, professional ethics, and willingness to participate in this process. The group of specialists consists of five, all with more than 15 years of teaching experience: two PhDs in Pedagogical Sciences, who are teacher trainers in the area of Natural Sciences, and three teachers from Ecuadorian basic education, two of whom hold a master's degree in Basic Education.

In the second stage, the specialists are given the proposal and an instrument consisting of a matrix with indicators that allows for the assessment of the relevance, coherence, and applicability of the strategies. In the third stage, the results are tabulated and analyzed, synthesizing the specialists' contributions and suggestions to adjust, strengthen, and refine the strategies before their implementation in the classroom. In the final stage, the report is prepared that includes the reflections, criteria and recommendations of the specialists. This process guarantees the applicability of the proposal, as shown in Table 1.

Table 1. Evaluation of specialists

Evaluation criteria	Specialist score (1- 10 pts)					Rating
	1	2	3	4	5	
Pedagogical relevance	9	10	9,5	9	9,8	**9,46**
Curricular coherence	10	9,8	9,5	10	10	**9,86**
Articulation between skill, objective, and assessment	9,5	10	9,8	9,5	9	**9,56**
Methodological clarity	10	9,5	10	9,8	9,5	**9,76**
Scientific rigor and character	9	10	9,5	10	9,8	**9,66**
Feasibility in rural and diverse contexts	9,5	9	9,5	9,8	9	**9,36**
Innovation and didactic value	10	10	9,5	10	9,8	**9,86**
Sociocultural relevance	9	9,5	9,8	9	9,5	**9,36**

Source: Own elaboration.

According to the results of this process, the proposed strategies comply with the required pedagogical, curricular, and scientific principles, respond to the characteristics of the students, the educational level, and the context, and effectively integrate digital tools. This ensures that their practical application will foster the development of meaningful learning, active participation, and the development of scientific, technological, and socio-emotional skills in seventh-grade students, contributing to the comprehensive education of students in Ecuadorian basic education.

Final decision: Their application will be approved with minor adjustments regarding the accessibility of the strategies in educational environments with technological limitations, such as rural contexts.

Conclusions

The research was based on theoretical foundations that highlight the importance of the pedagogical use of digital tools and active methodologies in the teaching of Natural Sciences, considering that these promote the construction of meaningful learning, critical thinking, and active student participation in their educational process. The diagnostic assessment revealed limited use of the potential of digital tools in the teaching and learning process of Natural Sciences, a scarcity of innovative strategies, and a tendency toward traditional teaching models. This limited scientific curiosity and the development of meaningful learning among seventh-grade students at the Shungumarca Educational Unit in the Cañar canton.

The proposed teaching strategies were evaluated by specialists, who confirmed that the proposal is consistent with pedagogical, curricular, and scientific principles. The specialists recognized that the teaching strategies based on the pedagogical use of digital tools are relevant and guarantee that their implementation in the teaching and learning process of Natural Sciences strengthens meaningful learning for seventh-grade students at the Shungumarca Educational Unit in the Cañar canton.

References

Alcívar, J., & Bowen, L. (2024). Educaplay para la enseñanza de las Ciencias Naturales en cuarto año de educación básica. *MQRInvestigar* 8(3), 4240–4263. https://doi.org/10.56048/MQR20225.8.3.2024.4240-4263

Ausubel, D. (1983). *Psicología educativa: un punto de vista cognoscitivo.* Trillas.

Castro, L., & Alanya, E. (2024). Herramientas digitales en el desempeño de los docentes: revisión sistemática. *Horizontes Revista de Investigación en Ciencias de la Educación 8*(32), 288-299. https://doi.org/10.33996/revistahorizontes.v8i32.723

Coello, S. (2023). Herramienta digital Google Classroom en la enseñanza aprendizaje de Ciencias Naturales en noveno año de Educación General Básica. *Latam: revista latinoamericana de Ciencias Sociales y Humanidades 4*(4), 83-98. https://doi.org/10.56712/latam.v4i4.1200

Espinoza, M. (2023). Recursos educativos digitales en la enseñanza de las Ciencias Naturales en la Educación Básica. *KIRIA:Revista CientíficaMultidisciplinaria 1*(1), 10-22. https://doi.org/10.53877/hgfk7c40

Madrigal, Y., Amayuela, G., & Cebrián, Y. (2025). La integración de recursos educativos digitales en la educación primaria rural. *Revista Tecnológica-Educativa Docentes 2.0*, 18(1), 34–42, https://doi.org/10.37843/rted.v18i1.592

Ministerio de Educación del Ecuador. (2023). *Reducción de la brecha digital en el Sistema Nacional de Educación.*

Piaget, J., & Inhelder, B. (2008). *Psicologia del niño* (17.ª ed.). Morata.

Rey, S. P., & Vergara, R. S. (2025). Los entornos virtuales como agentes del pensamiento creativo: Una revisión sistemática. *Revista Científica UISRAEL*, 12(1), 15-31, https://doi.org/10.35290/rcui.v12n1.2025.1110

Romo, G., Rubio, C., Gómez, V., & Nivela, M. A. (2023). Herramientas digitales en el proceso enseñanza-aprendizaje mediante revisión bibliográfica. *Polo del Conocimiento 8(10)*, 313-344. https://doi.org/10.23857/pc.v8i10.6127

Salinas, J., & De-Benito, B. (2020). Construcción de itinerarios personalizados de aprendizaje mediante métodos mixtos. *Comunicar*, *65*, 31- 42. https://doi.org/10.3916/C65-2020-03

Viñan, D., & Montoya, J. (2023). El uso de las TAC en el aprendizaje de ciencias naturales en estudiantes de sexto año del CECIB “Diego de Ibarra. *Polo del Conocimiento: Revista científico-profesiona 8(3)*, 828-851. https://doi.org/10.23857/pc.v8i3.5337

Vygotsky, L. (1979). *El desarrollo de los procesos psicológicos superiores.* Crítica.