

 Research Article

Podcasts as a Digital Tool in Biology Teaching

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Abstract

The digital age of the 21st century offers new generations creative and motivating spaces within the teaching and learning process. These tools, such as interactive platforms and multimedia resources, encourage active exploration of knowledge, especially in subjects like biology. Podcasts are an innovative tool in science education. Therefore, this research aims to design a system of activities that uses podcasts as a teaching resource to improve learning in biology, specifically in Unit 2: The World of Living Things: Unique or Diverse?, in the seventh grade at the “José Martí” Secondary School in the municipality of Pinar del Río. The study was conducted using a mixed-methods approach, adopting the dialectical-materialist method; theoretical and empirical methods were employed; specifically, historical-logical methods were used to conduct a systematic review of the literature published between 2020 and 2026, following the PRISMA guidelines, which allowed for the identification of the impact of podcast use in biology education, as well as empirical methods that included observation, surveys, and interviews. The results highlighted certain limitations in the teaching and learning of biology in seventh grade, primarily the lack of digital resources and teaching materials, as well as the limited use of active learning methods by teachers, while student participation and motivation were only partially evident. However, 79% of students reported having access to devices for listening to and watching audio and video content, and 85% expressed a preference for using podcasts in class, considering them useful for improving learning of difficult content while making classes more dynamic and interactive. These findings highlight the need to implement innovative teaching strategies that integrate podcasts into biology instruction to enhance student motivation and participation, as well as the importance of providing methodological training to teachers to ensure the effective incorporation of digital resources into the educational process.

Keywords: Didactic Resource, Digital Era, Learning, Podcasts

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1. INTRODUCTION

The growing use of digital resources in education has become a cross-cutting theme in the teaching-learning process at all levels of education. Educational podcasts are establishing themselves as an essential tool in contemporary education thanks to their ability to offer flexible and engaging access to knowledge (Grados et al., 2023).

In the discipline of biology in particular, they not only enrich the presentation of abstract concepts but also promote deep understanding and active learning. Podcasts stand out for their accessibility, allowing students to review complex topics in biology, such as mitosis, the cell as the structural and functional unit

of all living beings, and biodiversity. In this sense, they allow students to learn by listening anytime, anywhere, promoting personalized learning and adaptation to each individual's pace (Makina, 2020).

The field of biology education, characterized by its conceptual density and the need to understand abstract or invisible processes, benefits greatly from innovative pedagogical approaches that facilitate more effective access to knowledge by students (Sanchez et al., 2025).

This trend highlights the current educational problem, where the digital divide and lack of empirical evaluation limit its potential, despite its importance for mobile learning in contexts with high dropout rates in biology. Hence, the research aims to develop a system of activities using podcasts as a teaching resource to improve biology learning, specifically in Unit 2: The living world, unique or diverse?, in the seventh grade of the ESBU "José Martí" in the municipality of Pinar del Río.

1.1. Literature Review

The use of podcasts in biology teaching is a basic tool, as various authors have suggested in their research: Grados et al. (2023), Benítez (2023), Celarino et al. (2023), Bruna et al. (2024), and Sanchez et al. (2025). All of whom recognize the importance of including this teaching medium as an alternative learning method in order to achieve better results in the teaching and learning processes of students. In the field of education, mainly in the teaching of biology, podcasts allow for a different and practical understanding (Sanchez et al., 2025). Podcasts are a fundamental tool in classrooms where traditional media still persist, playing a significant role in informal learning (Barreiro, 2020).

In this regard, podcasts contribute to student motivation by highlighting the differences between various biology programs as a science, allowing them to be used at different times in their daily lives, both inside and outside of school, without the need for an internet connection. Podcasts were initially known for their popularity in the educational environment, thus achieving greater motivation to achieve adequate communication, given their ease of use and potential to diversify new teaching methodologies (Gutiérrez et al., 2023). According to Campuzano-Bello and Macías-Cedeño (2024), access to content in the form of podcasts offers a flexible way to review and progress in learning the topics taught during classes, strengthening a greater combination of information. Viscarra et al. (2025) argue that "podcasts allow teachers to diversify their teaching methods, incorporating external voices and perspectives that enrich lessons. In addition, these resources promote the development of listening and oral comprehension skills" (p.23), thus achieving a more meaningful and participatory teaching-learning process.

2. METHODOLOGY

The research was conducted using a mixed-methods approach, based on the dialectical-materialist method; therefore, theoretical and empirical methods were employed; a historical-logical approach was used to conduct a systematic literature review of studies published between 2020 and 2026, following the PRISMA guidelines (Page et al., 2021), which allowed for the identification of the impact of podcast use on biology instruction in secondary education. The literature review encompassed 14 peer-reviewed articles, doctoral theses, and guiding documents on secondary education in Cuba and other similar contexts, extracted from databases such as Academia.edu, ResearchGate, Google Scholar, Scopus, Scielo, and official repositories of the Ministry of Education and the Ministry of Higher Education in the Cuban context.

Empirical methods were used, such as observation of 8 biology classes. For its development, 9 indicators to be evaluated were taken into account: 1. Use of teaching media, 2. Use of digital resources, 3. Clarity in explanation, 4. Appropriateness of language, 5. Connection with everyday life, 6. Active participation, 7. Interest and motivation, 8. Active methods, 9. Attention to differences. Each indicator was evaluated qualitatively, recording evidence and concrete examples during the observed sessions, which allowed an approach to the research problem during the exploratory stage and its main manifestations in the socio-educational context.

The survey for the students consisted of 8 items and was carried out to identify the access, interest, and perception of seventh-grade students regarding the use of podcasts in the teaching-learning process of biology related to the contents of Unit 2: The Living World, Unique or Diverse?; for measuring the

responses, a 5-point Likert scale (from strongly disagree to strongly agree) was used for the items aimed at evaluating perceptions and attitudes, as well as a 3-point frequency scale (Never, Sometimes, Frequently) for the items related to usage habits. This combination allowed for obtaining both quantitative and qualitative data, facilitating a more complete analysis of the trends and opinions of the studied group.

For the interview with the teachers, a structured type, the participation of 6 seventh-grade teachers was included. The selection of the participants was carried out through intentional sampling, choosing those teachers who teach biology in the grade and who have previous experience in using technological resources in the classroom. The objective of the interview was to assess the level of knowledge, use, and willingness of the teachers to incorporate podcasts as a teaching resource in biology instruction. This approach allowed for obtaining relevant and contextualized qualitative information, directly linked to pedagogical practice and the possibilities for educational innovation in the field.

For the research, the population was made up of 158 seventh-grade students, of whom 78 were male and 80 female, aged between 12 and 13 years, from the ESBU “José Martí” in the province of Pinar del Río. From these, a sample of 53 students from seventh-grade 3 was selected, which represents 33.5% of the total. In addition, interviews were conducted with 6 teachers out of a total of 8, which represents 75%.

3. RESULTS

In the direct non-participant observation conducted on 8 seventh-grade biology classes, aimed at characterizing the teaching-learning process with emphasis on the use of teaching media and student motivation, consistent patterns were identified in the evaluated indicators. The main affected indicators included the use of teaching media, employment of digital resources, and attention to individual differences, which were recorded as “never” in all observed sessions. Meanwhile, indicators such as clarity in content explanation, adequacy of language to the seventh-grade level, relation of content to everyday life, active student participation, and use of active learning methods were predominantly rated as “sometimes,” evidencing partial and inconsistent application. Finally, interest and motivation during class showed an intermediate behavior, with a predominance of “sometimes,” suggesting opportunities for improvement through the integration of innovative strategies to enhance classroom dynamics and student engagement (Table 1).

Table 1. Main Results of Classroom Observations

Indicators	Main results
1-Use of teaching media	Never
2- Employment of digital resources	Never
3-Clarity in explanation	Sometimes
4-Adequacy of language	Sometimes
5-Relation to everyday life	Sometimes
6-Active participation	Sometimes
7- Interest and motivation	Sometimes
8-Active learning methods	Never
9-Attention to individual differences	Never

The survey was individually and anonymously administered to a sample of 53 seventh-grade students from group 3, yielding revealing results. Regarding access to devices for listening to audio (Item 1), 79% (n=42) reported availability of phones, computers, or other equipment. Listening to educational audio outside the classroom (Item 2) was frequent in 34% (n=18), occasional in 53% (n=28), and none in 13% (n=7).

General interest in biology classes (Item 3) was high, with 57% (n=30) expressing “a lot,” 36% (n=19) “a little,” and only 7% (n=4) “none.” An overwhelming majority (85%, n=45) expressed a desire for the teacher to use podcasts to explain topics (Item 4), considering that these would facilitate understanding (72%, n=38 “yes”; item 5), make classes more dynamic (77%, n=41 “agree”; item 8), and generated high interest in participating by recording audios (75%, n=40; item 7). However, current use of digital resources in class is moderate (28% frequent, n=15; 47% sometimes, n=25; 25% never, n=13; item 6).

As for preferred topics via podcasts (Item 9, multiple selections totaling 142 options; average 2.7 per student), the human body stood out (60%, $n=32$), animals (53%, $n=28$), environmental care (47%, $n=25$), plants (38%, $n=20$), and others (70%, $n=37$), among which genetics ($n=12$), ecosystems ($n=10$), and health ($n=15$) were prominent. These findings demonstrate significant potential for integrating podcasts into biology teaching, aligned with trends in educational innovation (Table 2).

Table 2. Student Interview Results

Item	Description	Detailed Results
1	Access to devices for audio	79% Yes ($n=42$); 21% No ($n=11$)
2	Listening to educational audio outside school	34% Many times ($n=18$); 53% Sometimes ($n=28$); 13% Never ($n=7$)
3	Interest in biology classes	57% A lot ($n=30$); 36% A little ($n=19$); 7% None ($n=4$)
4	Preference for teacher podcasts	85% Yes ($n=45$); 9% No ($n=5$); 6% Don't know ($n=3$)
5	Audio helps understand Biology	72% Yes ($n=38$); 23% Sometimes ($n=12$); 5% No ($n=3$)
6	Current use of digital media in class	28% Frequently ($n=15$); 47% Sometimes ($n=25$); 25% Never ($n=13$)
7	Interest in recording podcasts	75% Yes ($n=40$); 25% No ($n=13$)
8	Podcasts make classes more dynamic	77% Agree ($n=41$); 19% Somewhat agree ($n=10$); 4% Disagree ($n=2$)

A structured, anonymous survey was administered individually to six seventh-grade biology teachers at the secondary basic school. All teachers (100%, $n=6$) reported not knowing what a podcast is or its educational use (Item 1: No), not having used educational audio in seventh grade (Item 3: No), and never employing digital media in their classes (Item 2: Never), corroborating the absence of innovative practices identified in prior observations.

However, they considered podcasts highly suitable for biological content (Item 4: Very suitable, 100%), though they expressed disagreement on their contribution to student understanding (Item 5: Disagree, 100%). Regarding methodological preparation (Item 6), they responded partially (100%), identifying insufficient methodological preparation and a lack of didactic guidance (Item 7: 100% for both). They showed positive willingness to apply an activity system with podcasts (Item 8: Yes, 100%) and considered a guiding methodological proposal necessary (Item 9: Yes, 100%), suggesting plants as the most suitable content (Item 10). Regarding general data, all teach biology, with a predominance of Bachelor's degrees in Education and experience exceeding 10 years. These results reveal a gap between the perceived utility of podcasts and current training limitations, justifying specific pedagogical interventions.

The diagnostic study results confirm the existence of the scientific problem and the need to develop an activity system using podcasts as a didactic resource to improve biology learning, specifically in Unit 2: The Living World, Unique or Diverse?, for seventh grade at ESBU "José Martí" in the Pinar del Río Municipality.

3.1. System of activities using podcasts as a didactic resource to improve biology learning, specifically in Unit 2: Life: Unique and Diverse

The system of activities is organized into four interrelated and coherent phases: a first initial phase of stimulation and motivation, aimed at arousing interest and activating the senses; a second phase of knowledge construction, in which understanding and assimilation of content is facilitated; a third phase of application and self-regulation of learning, which promotes conscious reflection on what has been learned; and a fourth phase of socialization and evaluation, intended for presenting results and critically analyzing the process developed.

For the development of the proposal, the content system related to Unit 2: The Living World, Unique or Diverse? was taken into account, which includes:

2.1. In living organisms, unity and diversity are appreciated at the same time.

- 2.2. Organisms are made up of cells that constitute their basic unit of structure and function.
- 2.3. There are common characteristics in organisms, but these are not manifested equally in all.
- 2.4. To study the diversity of organisms, it is necessary to name and classify them scientifically.

Phase 1: Initial Stimulation and Motivation

This phase seeks to capture the attention of seventh-grade students from the outset, activating their senses and arousing curiosity about the unity and diversity of living organisms (contents 2.1 to 2.4). It consists of introductory activities with short, engaging podcasts, such as narrative audio featuring environmental nature sounds (e.g., bird songs or ocean noises) that illustrate biological diversity. The teacher leads a group brainstorming session post-podcast to connect personal experiences with the topics, fostering intrinsic motivation and preparing the ground for deep learning.

Example Podcast for This Phase

Podcast “Voices of Diverse Life” (Duration: 3-5 minutes). Narrate a “sonic journey” through Cuban ecosystems: sounds from a tropical forest (monkeys, birds), a coral reef, and an urban farm, with voice-over asking: “Do you hear the unity in diversity?”

Activity: Group listening + quick drawing of what was evoked. Objective: Activate senses and connect with 2.1 (unity and diversity).

Phase 2: Knowledge Construction

This phase focuses on understanding and assimilating the specific contents of the Cuban curriculum. Podcasts serve as the main resource, with structured episodes explaining key concepts: for example, one on cellular unity (2.2), another on common characteristics and variations (2.3), and a series on taxonomic classification (2.4). Activities include guided note-taking pauses, reflective questions embedded in the podcast, and pair discussions, enabling students to actively construct knowledge through accessible analogies, such as comparing cells to “bricks of life.”

Example Podcasts for This Phase

Podcast “The Cell: Brick of Life” (Duration: 7 minutes, 2-episode series). Explains cell structure and function with analogies (nucleus as “orchestra director”), Cuban examples (sugarcane cells), and pauses to repeat definitions. This activity addresses the content of section 2.2.

Activity: Note-taking in outline during pauses + oral quiz. Objective: Assimilate structural unity.

Podcast “Shared Traits, Infinite Variations” (Duration: 6 minutes). Compares common characteristics (respiration, reproduction) in humans, plants, and microbes, with variations (e.g., photosynthesis in Cuban mangroves). This activity addresses the content of section 2.3.

Activity: Collaborative concept map. Objective: Understand unequal manifestations.

Podcast “Classifying Cuban Life” (Duration: 8 minutes). Step-by-step taxonomy guide (domains, kingdoms) with local examples (Cuban crocodile in Animalia), using sonic mnemonics. This activity addresses the content of section 2.4.

Activity: Classification of five organisms heard. Objective: To name and classify scientifically.

Phase 3: Application and Self-Regulation of Learning

This stage promotes transferring learned content to real contexts and metacognition. Students apply the content by creating their own mini-podcasts about local examples of diversity in Cuba (e.g., endemic flora), recording them with cell phones. Self-evaluation rubrics are incorporated to reflect on strengths and errors, such as “How would you classify a mangrove according to content 2.4?” This fosters self-regulation, helping internalize biological unity and diversity through autonomous practice.

Example Podcasts for This Phase

Student Podcast “My Biological Discovery” (Duration: 4-6 minutes, created by students). Guided example: Student records classification of a Cuban animal (e.g., hutia), explaining cellular unity and variable traits, and self-evaluating accuracy.

Activity: Recording with script + personal rubric. Objective: Reflect on learned content.

Podcast “Sonic Debate: Unique or Diverse?” (Duration: 5 minutes, in pairs). Recorded dialogue discussing unity/diversity in Cuba (e.g., biodiversity in Viñales and cellular uniformity).

Activity: Self-analysis: “What would you adjust to improve?” Objective: Self-regulate overall understanding.

Phase 4: Socialization and Evaluation

Finally, products are socialized, and the process is evaluated collectively. Student podcasts are shared in a virtual or in-person “radio fair,” where peers and teachers comment on contributions related to the content. It includes critical analysis guided by questions like “How did your understanding of cellular unity (2.2) improve with this method?” Achievements are valued with formative feedback and adjustments for future cycles, closing the system with group reflection on the impact of podcasts on learning.

Example Podcast for This Phase

Podcast “Sonic Gallery of Biodiversity” (Duration: 10 minutes, group compilation). Mix of student podcasts with peer comments, highlighting successes in content (e.g., “Excellent taxonomy in 2.4”).

Activity: Radio fair + quick survey: “Did your learning improve?” Objective: Share and collectively evaluate.

4. DISCUSSION

The results of this study suggest that the use of podcasts as an educational tool in biology instruction can significantly contribute to the teaching-learning process by fostering both student autonomy and engagement with the curriculum, thereby enabling them to control the pace at which they access information, replay segments to reinforce understanding, and organize their study time independently, which fosters self-regulation and content retention thanks to flexible access and personalized learning. This aligns with previous research indicating that podcasts allow students to access content anytime and anywhere, promoting flexibility and personalized learning (Herrera, 2024).

The inclusion of contextualized examples in educational podcasts fosters a stronger emotional connection to the content, which leads to more active and sustained participation in academic activities; thus, the collaborative production of podcasts by students enhances communication skills, critical thinking, and teamwork, thereby reinforcing meaningful learning. Furthermore, the literature indicates that podcasts are useful resources for improving student retention and satisfaction, positively influencing academic engagement among college students (Espinosa Cevallos, 2024). This finding aligns with the results of our study, in which students reported greater interest and motivation when addressing complex biology content through audio episodes that complement traditional activities.

Another important aspect observed is the effectiveness of podcasts not only as a receptive tool but also as a collaborative and productive instrument, especially when students participate in their creation. Quantitative studies have shown that students who collaborate in the production of podcasts demonstrate significant differences in variables such as usability, design, and learning, highlighting the importance of active student participation in the educational process (Artiles et al., 2024).

In summary, the results confirm that implementing a system of activities mediated by educational podcasts constitutes a relevant and effective pedagogical strategy for teaching biology at the secondary level, consistent with the findings of Sánchez et al. (2025). The planned integration of this technological resource not only fosters student motivation and autonomy but also promotes a deeper understanding of biological content, provided it is incorporated into a teaching design consistent with curriculum objectives.

In this regard, the value of podcasts goes beyond their role as a technological resource and establishes them as an educational tool that enhances student-centered, active learning methodologies. These findings support the need to promote the intentional use of digital resources in science education, thereby contributing to the improvement of the teaching-learning process in biology.

The findings of this study offer explicit practical implications for various stakeholders in the field of education. For secondary school biology teachers, it is recommended to systematically integrate educational podcasts into lesson planning, starting with short episodes (5-10 minutes) that address key concepts such as biological cycles or ecosystems, allowing students to pause, replay, and access content via mobile devices to reinforce independent learning. Curriculum developers can incorporate mandatory modules on collaborative podcast production into curricula, allocating at least 20% of class time to this activity to foster communication and critical thinking skills. Educational researchers should prioritize longitudinal studies that measure the long-term impact on content retention, while policymakers could promote ICT teacher training policies by funding free podcasting platforms and resources tailored to local contexts, such as Cuba, thereby ensuring scalable and equitable implementation.

The current study has several limitations that must be explicitly acknowledged. First, the sample was limited to high school students from a specific institution, which restricts the generalizability of the results to broader educational contexts or to other educational levels and geographic regions. Furthermore, the duration of the intervention (one academic year) did not allow for an assessment of long-term effects on knowledge retention or sustained academic performance. Another issue is potential self-selection bias, as the volunteer participants may have shown greater initial motivation toward digital tools, thereby underestimating the impact on students with less access to technology or familiarity with podcasts. Finally, the absence of a strictly matched control group limits the attribution of causality exclusively to podcasts, suggesting the influence of confounding variables such as teacher enthusiasm.

Clear and specific guidelines are outlined for future research. It is suggested that the study be replicated with larger and more diverse samples, including rural and urban institutions across the country, using quasi-experimental designs with control groups and pre-test/post-test measures to strengthen internal validity. In addition, it is recommended to incorporate mixed-methods analyses that combine quantitative data (such as standardized tests of biological knowledge) with qualitative data (in-depth interviews on perceptions of autonomy), measuring variables such as self-regulation using validated scales. Finally, explore longer-term interventions (at least one school year) and compare podcasts with other ICTs (interactive videos or apps) through randomized controlled trials, prioritizing the development of standardized rubrics to assess the quality of student-produced podcasts and their correlation with meaningful learning.

5. CONCLUSION

The development of an activity system using podcasts as a didactic resource constitutes a pedagogical proposal aimed at enhancing biology learning in seventh grade, specifically in Unit 2: The Living World, Unique or Diverse?, at ESBU “José Martí” in the Pinar del Río municipality. Its design integrates contextualized activities and auditory resources that promote student motivation, attention, and autonomy by diversifying access routes to biological content. Likewise, the proposal is grounded in theoretical and methodological foundations that demonstrate its relevance for improving the teaching-learning process, requiring future implementation and evaluation to assess its real impact in educational practice.

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