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Educational strategies in microbiology to promote health and stimulate scientific thinking in children and adolescents.

Educational strategies in microbiology for health promotion and stimulation of scientific thinking in children and adolescents

Educational strategies in microbiology to promote health and encourage scientific thinking in children and adolescents

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1. INTRODUCTION

1.1 HEALTH EDUCATION

Health education is understood as an educational process aimed at promoting autonomy of individuals, enabling them to develop knowledge, skills and Attitudes related to self-care and care for the community. In this context, This constitutes an important strategy for promoting health and preventing disease. especially when inserted into contexts that favor the active construction of knowledge, such as the school environment (NOGUEIRA et al., 2022).

Historically, health education has been associated with practices focused on transmission. of information, which characterizes a vertical approach between educator and learner. In However, contemporary approaches have emphasized models with active participation of individual in the learning process, fostering the development of critical thinking. and the collective construction of knowledge. This perspective is aligned with conceptions pedagogical approaches that value the problematization of reality and the interaction between subjects in educational process.

In the context of public health, health education plays an essential role in Developing healthy habits from childhood contributes to the reduction of risk factors. and, consequently, for the prevention of diseases, especially infectious diseases. Studies show that educational interventions developed in the school environment can to promote significant changes in the behavior of children and adolescents, especially regarding the adoption of hygiene practices, such as proper hand washing. (KHAN et al., 2021).

Furthermore, health promotion is directly related to the dissemination of knowledge. Basic microbiology principles, since understanding microorganisms and their... Understanding transmission mechanisms is fundamental to adopting preventive practices.

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In this sense, studies indicate that a large proportion of human infectious diseases originate from... pathogens from other species, which reinforces the importance of health education as a tool for the prevention and control of these diseases (ELLWANGER et al., 2021).

Therefore, health education goes beyond the mere transmission of information. configuring itself as a dynamic and transformative process, capable of promoting change. behavioral and raise awareness about care and prevention practices. And, Without a doubt, when combined with appropriate pedagogical strategies, especially in The school environment becomes a powerful tool for the development of individuals. more aware, critical and committed to healthy practices.

1.2 Microbiology Applied to Everyday Life

Understanding the relationship between microorganisms and their interactions with humans in daily activities, especially those related to health, food, and the environment, is Essential. Often associated only with diseases, microbiology plays a crucial role. fundamental in several processes essential to life on Earth, including the production of food, ecosystem regulation, and the maintenance of the human microbiota. In this In this context, expanding knowledge about microorganisms becomes relevant both for both promoting health and adopting preventive practices. Another relevant aspect says with respect to the relationship between microorganisms and emerging diseases, especially those of origin Zoonotic. Studies indicate that a significant portion of human infectious diseases... It originates from pathogens of animal origin, which highlights the need to disseminate Basic knowledge of microbiology for the prevention of these diseases. (ELLWANGER et al., 2022).

In the healthcare field, the presence of microorganisms is directly related to the occurrence and... Prevention of infectious diseases. The transmission of pathogens can occur through different means. routes, including direct contact, contaminated food and surfaces, which reinforces the The importance of simple practices, such as proper hand hygiene. However, the Understanding microorganisms in everyday life helps to demystify the idea that all microorganisms are... harmful, as many perform beneficial functions, such as those involved in fermentation. of food and in the composition of the gut microbiota, which are essential to human health. The absence This lack of knowledge can contribute to the development of misconceptions about the role of

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microorganisms, reinforcing the importance of science education as a tool for
to broaden individuals' critical perspective on the role of microorganisms in daily life.
(NOGUEIRA et al., 2022).

In the school environment, the approach of microbiology applied to daily life can be
enhanced through active and contextualized methodologies that bring the content closer to the learner.
scientific analysis of students' reality. Strategies such as case studies, practical activities and
Investigative approaches promote the development of scientific thinking and allow
that students understand the importance of microorganisms in everyday life (ALEXANDER et
(al., 2024). In this way, microbiology applied to everyday life constitutes a fundamental axis.
for the promotion of health and the formation of more conscious and critical individuals. By relating
By relating scientific concepts to everyday experiences, it becomes possible to stimulate the interest of
students, promote behavioral changes, and contribute to the development of practices
Healthier and more sustainable.

1.3 Children and Adolescents as a Target Audience

Children and adolescents represent an important audience for health education initiatives.
especially in the school context, because they are in the phase of building habits, values and
behaviors that tend to persist throughout life. The literature shows that
Educational interventions at this stage have a greater potential for long-term impact.
contributing to disease prevention and the promotion of healthy lifestyles
(LANGFORD et al., 2022).

With regard to cognitive development, this age range, as included in this study...
as school-aged individuals, between 6 and 18 years old, exhibit a high capacity for
assimilation of knowledge, especially when it is presented in a way
contextualized and interactive. In this way, the use of active pedagogical strategies
It fosters not only the understanding of scientific content, but also the development
critical thinking and autonomy.

In the case of children, simple educational interventions adapted to their age group are also important.
They have proven effective in promoting healthy behaviors. Clinical trials conducted
Studies in educational institutions show that educational strategies focused on hygiene are effective.
Hands can significantly improve technique and frequency of this practice, contributing

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directly related to the prevention of infectious diseases. These findings reinforce the importance from the early introduction of content related to microbiology and disease prevention (WILLMOTT et al., 2021).

Furthermore, another relevant aspect concerns the role of children and adolescents as agents. Knowledge multipliers. By acquiring health information, these individuals They tend to share this knowledge with family and the community, expanding the The scope of educational interventions. Therefore, actions directed at this audience. They have the potential for impact not only individually, but also collectively, contributing for the dissemination of healthy practices in different social contexts (LANGFORD et al., 2022).

In short, consider children and adolescents as the target audience in educational initiatives. Health and microbiology proves to be an essential strategy for promoting health and Disease prevention. The use of pedagogical approaches appropriate to this age group. It enhances the results of educational interventions, contributing to the training of More critical, aware individuals capable of adopting healthy practices throughout their lives.

1.4 STIMULATING SCIENTIFIC THINKING

Scientific thinking can be understood as the ability to observe, question, To investigate and seek well-founded explanations for the phenomena of reality. In the environment In school, its development is related not only to learning content, but also to understanding how scientific knowledge is produced, tested and applied in everyday life. Therefore, science education plays an essential role in shaping... students who are more critical, reflective, and capable of understanding science as a construct. human and social (LIMA; SILVA, 2022).

Another relevant aspect concerns the development of student autonomy. As they are Encouraged to investigate and seek answers to problems, students begin to assume a role active in the knowledge-building process. Recent evidence highlights that the Autonomy is directly associated with the development of scientific thought, because It encourages informed decision-making and the ability to apply knowledge in... everyday life (MORAES et al., 2022).

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In this context, stimulating scientific thinking in basic education is fundamental, because
It fosters the development of curiosity and questioning, which are central elements for...
knowledge construction. When students are encouraged to ask questions, the
raising hypotheses and seeking answers makes them more participatory in the process of
Learning. Recent studies highlight that curiosity has an important relationship with...
School engagement and engagement with science learning, reinforcing the need for practices
pedagogical approaches that value research and active student participation (EVANS et al.,
2023; KHURMA; JARRAH; ALI, 2025).

Furthermore, encouraging scientific thinking is of great importance in the context of
microbiology, since this area allows for the observation and problematization of situations
of daily life, such as hygiene, health, nutrition, and disease prevention. By relating
By integrating microbiological concepts into students' experiences, teaching becomes more meaningful.
and contributes to the development of the ability to analyze and interpret information.
phenomena and adopt more conscious attitudes. Thus, encouraging curiosity,
Questioning and fostering autonomy in microbiology education constitutes an important strategy.
both for health education and for the scientific training of students (ANTONIO;
PRUDENTE, 2024).

Therefore, encouraging scientific thinking in the school environment is configured as a
A fundamental strategy for health education, as it promotes the development of
curiosity, questioning, and student autonomy contribute to their development.
of individuals who are more aware and capable of making informed decisions in their daily lives.

1.5 JUSTIFICATION AND OBJECTIVE OF THE STUDY

Given the importance of education in the school environment, and the need to expand the
understanding the application of microbiology to everyday life and the importance of stimulating it.
Given the importance of scientific thinking from the earliest stages of life, further discussion becomes relevant.
about how these dimensions have been articulated in the scientific literature. The school is configured-
if it serves as a strategic space for the development of educational actions aimed at
health promotion, since it allows the formation of knowledge, attitudes and practices that
These effects can last a lifetime. Recent systematic reviews demonstrate that programs
School health promotion programs have the potential to encourage healthier habits.

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to broaden the understanding of health issues and contribute to the well-being of children and adolescents, reinforcing the relevance of this field of research (PÉREZ-JORGE et al., 2021).

Therefore, microbiology assumes an important role, as it makes it possible to address these issues. directly related to the students' daily lives, such as hygiene, nutrition, and prevention. of diseases and the understanding of microorganisms in different contexts of social life. When approached in a contextualized way and linked to the students' reality, this area of Knowledge can go beyond the mere transmission of content and contribute to a more holistic education. more critical and significant. In addition to supporting health education practices, the teaching of Science education guided by scientific literacy perspectives promotes understanding of Science as a tool for understanding the world and for social transformation, which further expands... further the relevance of the present topic (FERNANDES et al., 2024).

Furthermore, investigate educational strategies in microbiology aimed at children and adolescents are shown to be important because this age group corresponds to a decisive period. for the formation of habits, values, and ways of understanding reality. Recent literature highlights that educational interventions carried out in educational institutions can produce lasting positive effects, especially when developed in a participatory manner. contextualized and compatible with the needs of the target audience. Thus, understanding how Different strategies have been used in the literature that can contribute to identifying more effective approaches to bringing scientific knowledge closer to lived experiences by children and adolescents, strengthening both health education and interest in science (FINANCZ et al., 2023).

Furthermore, the choice of this theme is justified by the need to gather and organize evidence. Recent studies on the contributions of educational strategies in microbiology to the developing students' curiosity, questioning skills, and autonomy. To synthesize these findings, an integrative review can offer important theoretical support for... teaching practice, for the development of educational activities in the school context and for the Strengthening proposals that link science education, health promotion, and... scientific training. In this way, the study not only responds to an academic demand of It is a synthesis of knowledge, but it also has practical relevance in supporting interventions. more critical, meaningful, and socially committed pedagogical approaches.

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Finally, the aim of this article is to analyze, in the scientific literature, which Educational strategies in microbiology have been used with children and adolescents and of In what way do these strategies contribute to promoting health and stimulating... scientific thinking.

2. METHODOLOGY

This study is characterized as an integrative literature review, conducted with the objective of gathering, analyzing, and synthesizing scientific productions on educational strategies in microbiology focused on promoting health and stimulating scientific thinking in Children and adolescents. This type of review allows for the organization of available knowledge. on the subject, contributing to a broader understanding of the findings in the literature and to Identifying evidence relevant to the discussion proposed in the study.

The construction of the review was guided by the following guiding question: what strategies Educational methods in microbiology have been used to promote health and stimulate... Scientific thinking in children and adolescents? Based on this question, the following were defined... thematic axes of the bibliographic search, in order to include studies related to microbiology, health education, science teaching, scientific thinking and Children and young people.

The search for studies was conducted in February and March of 2026, in the databases. PubMed, SciELO, and the Virtual Health Library (VHL) are recognized sources in... Indexing of scientific publications in the areas of health and education. To locate the articles, Descriptors in Portuguese, English, and Spanish were used, in accordance with the guidelines of study and the scope of the databases consulted.

Among the main descriptors used, the terms microbiology and health stand out. education, science education, child and adolescent, as well as their counterparts in Portuguese (Brazil): microbiology, health education, science teaching, children and adolescents. The The terms were combined using the Boolean operators AND and OR, as per... The need to refine the search in each database. Among the combinations performed, the following stand out: if expressions such as microbiology AND health education AND child, microbiology AND science education AND adolescent, in addition to combinations in Portuguese, such as microbiology. AND health and microbiology education AND science education, including research. Compatible languages in Spanish. Combinations related to games were also considered.

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teaching materials, inquiry-based learning, hand hygiene, health literacy, teaching aids.
Critical thinking and scientific misinformation, in order to broaden the final sample of studies.

As inclusion criteria, complete scientific articles available in [context missing - likely a platform or database] were considered.
complete texts, published in the last five years, in Portuguese, English or Spanish, and that
that presented a direct relationship with the proposed theme, addressing educational strategies in
microbiology, health promotion, science education or stimulation of scientific thinking
in children and adolescents. The following were excluded: duplicate articles,
studies outside the proposed theme, publications without access to the full text, and works that,
After reading the summary and the full text, they did not sufficiently address the question.
guiding.

The selection of studies occurred in successive stages. Initially, the following was read:
titles of the works identified in the searches, with the aim of excluding those that are clearly not
related to the topic. Next, the abstracts were read in order to verify the...
The relevance of the studies in relation to the guiding question and eligibility criteria.
Subsequently, potentially relevant articles were submitted for full-text reading.
This step allowed for the final confirmation of the inclusion of the selected studies and the identification of...
Information regarding the location, type of study, target audience, and strategy.
The educational approach employed and the main results observed.

At the end of the search and selection process, 507 articles were identified. After applying the
Based on inclusion and exclusion criteria, 15 articles were selected for the review.
integrative. These studies were analyzed descriptively and organized according to
Information such as author and year of publication, study objective, target audience, strategy.
educational methodology used and main results, allowing for a comparison between the findings and the
construction of the thematic categories discussed in the article. The expansion of the sample allowed
to encompass a more diverse set of investigations, including studies directly
geared towards teaching microbiology, such as educational games, teaching practices and resources.
digital, as well as studies related to health education, health literacy, and
hand hygiene, oral health, and combating scientific misinformation in the context
school.

In this way, the methodology adopted made it possible to gather recent and relevant evidence about the
The use of educational strategies in microbiology with children and adolescents, promoting
analysis of their contributions to health promotion and the stimulation of thought

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scientific. This synthesis of studies allowed for a comparison of the results with each other, to identify Methodological similarities and differences, and grouping the findings into thematic categories. promoting critical analysis and the construction of results and discussion sections.

3. RESULTS AND DISCUSSION

The analysis of the included studies allows us to understand that educational strategies aimed at Microbiology and health promotion have greater formative potential when they are combined. scientific content, active student participation, and contextualization with real-world situations. everyday life. In general, research converges in indicating that teaching is becoming more... significant when it ceases to be focused solely on the transmission of concepts and begins to to involve concrete experiences, playful resources, investigation, and problem-solving. In this In this sense, even though the articles present distinct methodological designs, there is... They are drawing closer by advocating for educational practices that promote greater engagement. of the students, applied understanding of the content and strengthening of preventive attitudes in health (TORRES et al., 2020; SILVA et al., 2021; BARBOSA et al., 2024).

When analyzing studies more directly focused on the teaching of microbiology, it is observed that Educational games, comic books, teaching practices, and educational apps. They share a common goal: to reduce the abstract nature of microbiology and bring people closer together. students of a universe that, because it involves organisms invisible to the naked eye, frequently It is perceived as distant and difficult to understand. In this context, playful, visual resources, Practical and digital tools help bring microbiological concepts closer to the students' reality. encouraging interaction, curiosity, and active participation. Thus, although they use supports Although different, these studies point in the same direction: learning tends to be favored. when microbiological content is mediated by resources that stimulate curiosity, the participation and the active construction of knowledge (SILVA; OLIVEIRA; HARDOIM, 2022; BARBOSA et al., 2024).

Studies focused on hand hygiene, health literacy, and change in Behavioral data shows that the effectiveness of interventions depends not only on information. offered, but also in the way it is experienced by the students. Demonstrations practices, visualization of waste, school festivals, provision of materials and interventions. Multicomponent therapies produce better results when combined with active participation and... repetition of desirable behaviors. Unlike studies that focus more on

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In formal microbiology education, these interventions prioritize the incorporation of habits and preventive practices. Even so, the two study groups converge in demonstrating that Learning is strengthened when the student is able to relate the content to their own life. and recognize its concrete usefulness (ERKOCA et al., 2025; PIETERS et al., 2025).

This evidence helps explain why certain strategies prove more effective. The methodologies that yield the best results are precisely those that combine participation, contextualization, and active mobilization of the student, whether through games, Practical observation, problem-solving, group discussion, or content creation. This This occurs because such approaches favor not only the memorization of information, but also... also the attribution of meaning to what is learned. When microbiology is associated with situations such as hygiene, disease transmission, human microbiota, vaccination, sanitation or critical verification of health information, knowledge comes to be perceived as Useful and applicable, which tends to increase interest, engagement, and retention of content.

Therefore, the effectiveness of the strategies does not seem to derive solely from the resource itself, but also in the way that this promotes the link between scientific knowledge and everyday experience. (TORRES et al., 2020; BARBOSA et al., 2024; KHANAL et al., 2025; SILVA et al., 2025).

In this context, microbiology, as an educational tool, assumes a particularly important role. This is relevant because it allows for the articulation of science, health, and daily life in a very concrete way. Unlike an approach restricted to the classification of microorganisms or to Regarding memorization of definitions, the studies analyzed show that microbiology can be... studied as a field capable of explaining phenomena present in daily life, such as contamination, infection, prevention, body function, and the relationships between microorganisms and the environment. This characteristic enhances its pedagogical potential, since it contributes not not only for learning scientific content, but also for the formation of attitudes. related to self-care, disease prevention, and critically analyzing health situations.

Thus, microbiology proves to be a privileged subject for integrating science education and... health education in the school environment (COELHO JÚNIOR et al., 2020; SILVA et al., 2021; SILVA; OLIVEIRA; HARDOIM, 2022).

Another important aspect concerns the relevance of active methodologies. The findings of Reviews reinforce that investigative, playful, and participatory strategies favor the Learning goes beyond immediate learning: it contributes to development. skills related to scientific thinking, such as observing, formulating hypotheses, Analyze information, discuss evidence, and construct interpretations. In these studies, the

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Students not only receive content, but are also encouraged to reflect, discuss, and evaluate.
critically analyze information and take a stand on problems. In this way, the methodology
Active learning should not be understood merely as a resource to "motivate" the class, but as a
a path that can broaden students' intellectual autonomy and foster a more...
critical analysis of scientific knowledge and health information (MARTINI et al., 2025;
SILVA et al., 2025).

The discussion also highlights the role of the school as a strategic space for articulating the
Scientific training for health promotion. Studies show that school doesn't just function...
as a place for transmitting curricular content, but also as a privileged environment
to build habits, discuss real problems, develop literacy skills in
health and strengthen students' ability to make more informed decisions. This becomes
This is even more relevant when considering that many of the interventions analyzed address
issues directly related to students' lives, such as hygiene, nutrition, mental health, use
media, disease prevention, and body care. Thus, the school space presents itself
as a scenario capable of integrating the cognitive, social, and behavioral dimensions of
learning, expanding the educational reach of the actions developed (PIETERS et al., 2025;
SILVA et al., 2025; HOSSEINI et al., 2025).

Furthermore, studies on health literacy and combating misinformation broaden the...
The discussion shows that, in contemporary times, the scientific education of children and adolescents is not...
It depends not only on mastering concepts, but also on the ability to critically evaluate them.
information circulating in digital environments. In this sense, the school's contribution will be...
In addition to teaching microbiology or health content, it involves creating conditions
so that students learn to distinguish reliable information, interpret evidence, and...
Resisting pseudoscientific or misleading content is especially important.
because it brings science education closer to the informational reality experienced by teenagers,
making the relationship between scientific thought, autonomy and citizenship more visible (SILVA
et al., 2025; MARTINI et al., 2025).

Finally, the review indicates that the contribution of the educational strategies analyzed is not...
It is not limited to the punctual improvement of school performance nor to the adoption of behaviors.
specific. More broadly, studies suggest that pedagogical practices
Contextualized, participatory approaches grounded in real-world problems can contribute to...
forming more critical individuals, more aware of their health and more capable of understanding
The relevance of science in everyday life. Therefore, discussing microbiology in the school context,

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When combined with active methodologies and health education, it also means investing in A training program that combines knowledge, autonomy, prevention, and scientific thinking. fundamental dimensions for the integral development of children and adolescents (BARBOSA et al., 2024; KHANAL et al., 2025; HOSSEINI et al., 2025; SILVA et al., 2025).

4. DATA ORGANIZATION

To facilitate the analysis of the included studies, the selected articles were organized into a table that includes author and year of publication, objective, target audience, educational strategy and main results.

Table 1 - Characterization of the studies included in the integrative review.

Author and year	Study objective Target audience		Educational strategy used	Key results
Coelho Júnior et al. (2020)	To present a story in comics as a resource for	Specialist no readers, and educational audience.	A comic in book story with a playful narrative in an environment...	The comic book was considered an easy-to-read resource and
	To facilitate the understanding of topics related to *Escherichia coli* and microbiology.		laboratory.	Visualization Pleasant, with the potentia to facilitate to the understanding of complex microbiology topics. of

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Torres et al. (2020) Developing and evaluating a microbiology educational game related to everyday life.	and to the	Science and biology teachers and groups of high school students.	of	Educational board game about microbial contamination, hygiene, sanitation, vaccination, and environmental preservation.	and	The game was widely praised and considered a motivating and engaging learning tool for microbiological content in the school curriculum.	node
Silva et al. (2021) Developing pedagogical practices aimed at teaching microbiology in elementary education.	node	Approximately 60 students from the 7th grade of elementary school.		Lectures and pedagogical practices with students. The application of a semi-structured questionnaire topics such as hygiene and microorganisms better,		helped them understand the pathogenicity of although they still had difficulty defining microbiology precisely.	
Amon-Tanoh et al. (2021)	To evaluate the effect of a social norms-based intervention on the Wash your hands with soap after using the toilet.	Residents of together Urban housing for young with children in Abidjan, Ivory Coast.		Intervention based on social norms. with messages of of disgust associated with feces and the offer of a handwashing station.		Social intervention combined with a hygiene station. increased	the washing hands with soap, with a stronger and more effective result
						Supported because The offer is separate from the station.	

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Khan et al. (2021) Assessing knowledge about handwashing and the effectiveness of intervention on Hand hygiene techniques for schoolchildren.	the	93 children from the 2nd grade with an average of 6 and 7 years old, in a practical demonstration of hand washing techniques, video was a significant improvement in hand hygiene, in both groups.	and glow gel with ultraviolet	in light in both groups. There
Silva, Oliveira and Hardoim (2022)	Develop 30 teachers' application to validate the biology application for the public educational network of Mato Grosso's MicroBio educational program. Inquiry-based teaching of microbiology.	one	Bacteria.	The application was considered relevant for understanding the biology of gut microbiome bacteria and for To make classes less abstract and more motivating.
Barbosa et (2024) al.	Analyzing the potential of the Microbiology Chessboard as a tool for high school education.	the 67 students in their second year of high school, aged between 16 and 18 years old.	Game didactic included in in an investigative teaching sequence based on cycle 5E.	The use of the game enhanced the the teaching and learning process in microbiology, increasing student participation, the interest, and the engagement and the with the content. to the
Aké Canul et al. (2024)	Implement primary school was a multicomponent initiative that enabled more active public educ practices to promote rural Yucatán, a region with compromised habits.	Schoolchildren of a	Intervention	The intervention in the ation and health management

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	Handwashing in schoolchildren.	Mexico.	Environmental Community behavior and of modification.	With handwashing among schoolchildren.
Fontes et al. (2024) Report the experience of developing didactic-	pedagogical material for teaching microbiology.	Primary and secondary school teachers; material intended for high school students aged 14 to 18.	A card game adapted from Yu-Gi-Oh! to address viruses, fungi, and bacteria.	The material was designed to stimulate to interaction, the learning, the and... Development of intellectual skills related to microbiology. the
Pieters et al. (2025) Evaluating school	one intervention on hand hygiene and cleaning practices in primary schools in Guatemala.	Students aged 8 to 13 from six primary schools.	Educational campaign with handwashing Festivals and increase access to soap and hand sanitizer.	There was an improvement in hand hygiene, although adherence to proper hygiene showed mixed results, indicating that... The need for sustained strategies.
Khanal et (2025) al.	Evaluate the the effectiveness of School intervention in health literacy for between adolescents.	468 ninth-grade students from community schools in Surkhet, Nepal.	Multicomponent intervention, in 13 sessions, with a framework the SHOWED.	There was a significant improvement in health literacy, self-efficacy, and in... in intention to adopt actions that promote health.

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Silva et al. (2025) Identifying	health literacy demands of among in adolescents and	Teenagers aged 14 to 19 from two public schools in Rio de Janeiro.	Brainstorming, discussion circles, broadened active listening and engagement, and restructured the appropriation of content.	The intervention, using the
	Implement co-created digital educational strategies.		Instagram node content and on TikTok.	Health for teenagers.
Hosseini et al. (2025)	To the evaluate the effectiveness of school intervention in promoting oral health literacy. in	140 female students, aged 15 to 19, from Four sessions schools, secondary school questions, answers, of practical demonstrations, videos, pamphlets and slides. Gorgan, in Iran.	Educational lectures with and	The intervention improved things significantly. the total oral health literacy score and its respective domains.
Martini et (2025) al.	To the evaluate the effectiveness of three educational interventions to help high school students identify scientific misinformation.	2,288 high school students from northern Italy.	Interventions: There was no significant global improvement in Civic Online Reasoning, in identifying Cognitive Biases and misinformation, in scientific research, but the classroom study highlighted the importance of improving educational strategies to strengthen digital and critical literacy.	to the

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Erkoca et al. (2025)	To examine the effect of hand hygiene education on the behavioral scores of secondary school students.	Students in grades 5 through 8 at a school in Ankara, Türkiye.	Educational sessions and control group.	Following the in-person educational program, there was an increase in hand hygiene, with a statistically significant quasi-experimental design in the... scores of Behaviors related to hand hygiene.

Organizing the studies in the table allows us to understand the importance of bringing together different...
research on educational strategies in microbiology, especially highlighting that each
This proposal contributes, in some way, to bringing scientific knowledge closer to reality.
of the students. By observing the objectives, target audiences, strategies used and results.
As these results show, it becomes clearer that microbiology education can go beyond mere theoretical explanation.
of the content, also encompassing aspects related to health promotion and prevention.
of diseases and the development of critical thinking.

Therefore, the studies analyzed show that resources such as games, pedagogical practices,
Educational interventions, digital materials, and participatory actions can make learning more accessible.
most significant, as they encourage student engagement and allow them to understand the
The usefulness of scientific knowledge in everyday life. Therefore, the analysis of these works reinforces this point.
the importance of investing in more contextualized and accessible methodologies, capable of
to awaken the interest of children and adolescents and to contribute to a more comprehensive education.
conscious, participatory, and focused on individual and collective care.

CONCLUSION

The aim of this study was to analyze, in the scientific literature, which strategies
Educational methods in microbiology have been used with children and adolescents, but in what way?
These strategies contribute to promoting health and stimulating thought.
scientific. From the integrative review carried out, it was identified that different approaches
Educational methods have been employed in the school context, with particular emphasis on educational games.
investigative practices, visual materials, digital resources, educational campaigns and

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participatory methodologies, highlighting the diversity of possibilities for teaching microbiology and for health education.

The main findings indicate that these strategies have the potential to promote Learning microbiological content, increasing student engagement, strengthening preventive health practices and contribute to the development of related skills. to curiosity, questioning, autonomy, and critical reflection. In general, studies The analyses suggest that the most promising interventions are those that bring the scientific knowledge relevant to students' daily lives and places them in an active position in the process. of learning, making teaching more meaningful and socially relevant.

In this sense, microbiology proves to be a particularly important subject in The school environment, as it allows for the connection of scientific concepts to concrete themes of daily life, such as hygiene, disease prevention, nutrition, human microbiota, vaccination and care with the body. When worked on in a contextualized way, this area of knowledge It goes beyond simply transmitting definitions and begins to contribute effectively to the health education, promoting the understanding of fundamental biological processes for the adopting preventative behaviors and training students to be more aware of for their own health and that of the community.

Furthermore, the findings of this review reinforce the idea that microbiology education, when When combined with active learning methodologies, it can significantly contribute to development. of scientific thought. By stimulating observation, investigation, analysis of information, the Formulating hypotheses and critically evaluating content are strategies that favor... training children and adolescents to be more critical, participatory, and capable of using the scientific knowledge can be acquired more autonomously in everyday situations. In this way, the Microbiology education is no longer limited to an informative role and is now also taking on a... formative function, both in the field of science and in the field of health.

In conclusion, educational strategies in microbiology constitute an important... A resource for integrating scientific education with health promotion in the school environment. A summary of The studies analyzed offer relevant insights for teaching practice and for the development of... more critical, participatory, and contextualized educational actions, pointing to the school as a privileged space for the development of proposals that articulate science education, Disease prevention and the encouragement of scientific thinking among children and adolescents.

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