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Health literacy and convergences with inquiry-based teaching: possible approaches and implications for scientific training

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ABSTRACT

Health Education can be developed through quality education, forming part of the Sustainable Development Goals - ODS. Inquiry-Based Learning is considered a teaching perspective with the potential to meet the educational demands of students in today's society regarding issues related to Health Education. This study aimed to discuss the connections between Inquiry-Based Learning and literacy levels in their theoretical aspects and how these potential convergences relate to students' health and scientific education. This is a qualitative research study. The theoretical study was conducted analyzing the foundations of Inquiry-Based Learning and health literacy levels, aiming to observe their convergences and their contributions to student development. The results point to a possible and promising relationship between the use of investigative activities, as contemplated in Inquiry-Based Learning, and higher levels of health literacy, a goal for individuals' civic and scientific development.

KEYWORDS: Inquiry–Based Teaching; Health Education; Health Literacy.

Literacia em saúde e convergências com o ensino por investigação: possíveis aproximações e implicações para formação científica

RESUMO

A Educação em Saúde pode ser desenvolvida por meio da educação de qualidade, compondo parte dos Objetivos de Desenvolvimento Sustentável - ODS. Considera-se que o Ensino por Investigação é uma perspectiva de ensino com potencial para atender as demandas formativas dos estudantes na sociedade atual para questões relativas à Educação em Saúde. Este estudo teve por objetivo discutir as aproximações entre o Ensino por Investigação e os níveis de literacia em seus aspectos teóricos e como essas possíveis convergências se articulam para a formação em saúde e científica dos estudantes. Trata-se de uma pesquisa qualitativa, na qual procedeu-se a um estudo teórico com análise dos fundamentos do Ensino por Investigação e os níveis de literacia em saúde, no intuito de observar suas convergências, bem como contribuições para a formação do estudante. Os resultados apontam para uma relação possível e promissora entre a utilização de atividades investigativas, contempladas no Ensino por Investigação e os níveis mais elevados de literacia em saúde, almejado na formação cidadã e científica dos indivíduos.

PALAVRAS-CHAVE: Ensino por Investigação; Educação em Saúde; Literacia em Saúde.

INTRODUCTION

We live in a world where science and technology are advancing significantly. The impacts of this progress are positive, yet questionable in many respects. As scientific and technological knowledge advances, we are witnessing the rise of denialist movements—such as the anti-vaccine movement—that express a lack of faith in science, posing one of the emerging challenges to individuals' scientific training and education. (Da Silva et al., 2019; Bonfin and Strieder, 2024).

Pulimeno et al. (2020) discuss the health challenges faced by young people in the 21st century, such as high consumption of fats and sugars, coupled with a lack of physical activity, which contributes to obesity, smoking, alcohol consumption, and other issues. In this regard, the demands of current society point to the need to educate reflective individuals capable of making informed decisions based on scientific knowledge.

The document from the United Nations (UN) for Education, Science and Culture (UNESCO, 2015) defines science education as essential for the development of scientific literacy across all cultures and sectors of society. The document notes that science education fosters reasoning skills and abilities that contribute to citizens' public participation in decision-making. According to this document, 'governments should give the highest priority to improving science education at all levels' (UNESCO, 2025, p. 56). This knowledge provides educational and intellectual enrichment and is essential for living in contemporary society, particularly when it comes to issues involving health promotion.

In this context, the UN recognizes education as a key factor in improving the health of young people and emphasizes the need to achieve the Sustainable Development Goals (SDGs), as proposed at the UN General Assembly session titled "Transforming Our World: The 2030 Agenda for Sustainable Development" (United Nations, 2015). Among the SDGs, Goal 3 relates to Good Health and Well-being; Goal 4 refers to Quality Education, drawing attention to integrating approaches that combine science education and health promotion. In this sense, schools are recognized as an appropriate setting for developing health promotion initiatives, as they are the primary environment where students acquire scientific knowledge and develop conscious skills and attitudes regarding health-related issues through this knowledge (WHO, 1998a, 1998b).

The link between SDG 3 and SDG 4 highlights the central role of schools as a locus of social transformation, by providing not only access to scientific knowledge but also a well-rounded education for individuals. From this perspective, education contributes to the adoption of healthier and more mindful practices, establishing itself as a cornerstone for achieving the goals outlined in the 2030 Agenda.

However, the link between science education and health education is not limited to a simplistic presentation of content, based on the assumption that the educational process is intended solely to convey information (Mohr, 2002). The relationship between these fields of knowledge can contribute to a person's holistic development. Aranda (2008) corroborates and affirms that education should encourage students to acquire competencies and skills related to scientific

activity in order to understand and resolve several everyday situations and problems, such as those related to health.

In this regard, a concept that emerged in the 1970s is 'Health Literacy.' It was introduced into scientific literature by Simonds (1974) in the context of health education. The article “Health Literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century,” published by Nutbeam (2000), points out that Health Education aims, for individuals, to develop Health Literacy and classifies it into three levels: functional, interactive, and critical.

There is a clear connection between scientific education, health literacy, and health education, aimed at raising aware and critical-thinking individuals. However, studies by Luquez et al. (2021), Venturi & Mohr (2021a), and Lourenço & Zompero (2025) assert that health education in Brazilian schools still exhibits a normative tendency. In this context, emphasis is placed on changing students’ behavior, based on a biomedical approach focused on the biological aspects of diseases. This trend does not aim to foster students’ critical thinking and does not contribute to effective health literacy. Therefore, schools need to employ appropriate teaching methodologies to achieve the proposed objectives, both in terms of scientific education and health education.

Considering the demands and guidelines outlined here, we believe schools must adopt practices that foster reflection, argumentation, and critical thinking. Given this scenario, inquiry-based teaching is a teaching approach that can contribute to the understanding of concepts, the development of higher-order cognitive skills, reflection, and informed decision-making (Zoller, 2001; 2012). Therefore, it is necessary to clarify how inquiry-based teaching and critical trends in health education intersect to promote health literacy. Thus, this study aims to examine how inquiry-based teaching relates to different levels of health literacy, with a view to fostering health education from a reflective perspective.

In light of the above, the objective of this study is to examine the connections between inquiry-based teaching and literacy levels from a theoretical perspective, and to explore how these potential connections relate to students’ health and scientific education.

METHODOLOGY

This study can be characterized as a theoretical essay, understood as a reflective and analytical work based on theoretical frameworks, without necessarily involving empirical research (Ludke & André, 1986). It is a qualitative study. A theoretical study was conducted on the fundamentals of inquiry-based teaching and frameworks related to health education, aiming at identifying convergences and connections between the elements of Inquiry-Based Teaching and levels of health literacy (Nutbeam, 2000; 2008) and implications for student training.

BASICS OF INQUIRY-BASED TEACHING

Inquiry-based teaching is a pedagogical approach that emphasizes active participation, intellectual autonomy, and student engagement in situations that resemble scientific practice (Zompero & Laburú, 2011; Zompero et al., 2024). Unlike traditional teaching, which focuses on the direct transmission of content, IBL proposes that students draw on prior knowledge, formulate and test hypotheses, collect and analyze data, construct explanations, and debate arguments in a continuous process of inquiry (Baptista, 2010; Zompero et al., 2025). This model does not merely teach science content; it enables students to gain a better understanding of the nature of scientific knowledge.

According to international documents, such as those from the National Research Council (2012) and the European Commission (2015), the implementation of inquiry-based teaching must take into account certain fundamental characteristics. Among these are engaging students in solving problem situations; sparking curiosity through open-ended and contextualized questions; enabling students to identify evidence; encouraging the search for data to support explanations; fostering the relationship between data and scientific concepts to argue scientifically; facilitating the communication of knowledge; and promoting the socialization and negotiation of constructed explanations.

The relevance of inquiry-based teaching is also evident in various dimensions, such as fostering critical and reflective thinking; it contributes to the development of scientific literacy, understood as the ability to understand, evaluate, and apply scientific knowledge in social, technological, and environmental contexts. Duschl (2008) argues that these dimensions should be implemented in the classroom context to contribute to students' scientific education.

Although it has gained prominence in recent decades, inquiry-based teaching is not a recent concept; its origins date back to the late 19th century. In the early 20th century, curriculum reforms in various countries emphasized the importance of teaching science as an investigative practice, preparing citizens to be critical and technologically competent (DeBoer, 2006; Baptista, 2010; Zompero et al., 2025). As we enter the 21st century, the understanding has taken hold that inquiry-based teaching is closely linked to the development of scientific literacy (Anderson, 2002; Bybee, 2006). This means that its role is not limited to training future scientists but rather seeks to prepare citizens who can understand, evaluate, and participate in debates about science, technology, and society.

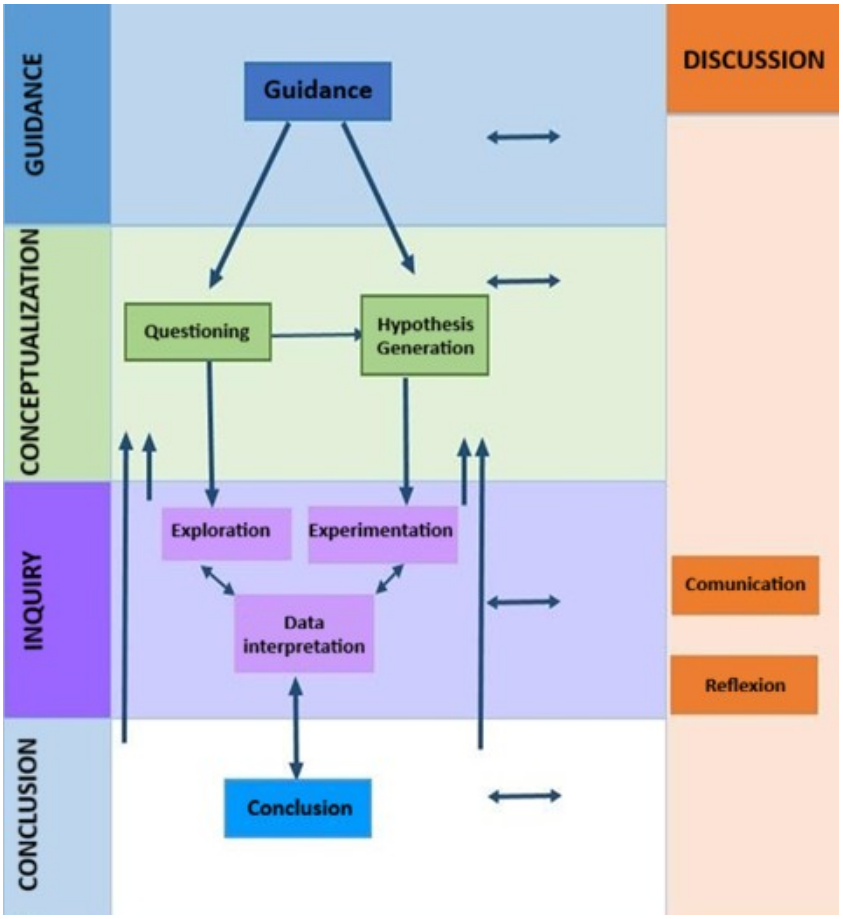
Scientific literacy involves not only understanding concepts but also the ability to apply them to interpret phenomena, make informed decisions, and engage in public discourse (Roberts, 2007; Baptista, 2010; Martins, 2019).

Studies in the relevant literature highlight essential elements that should be included in the investigations students conduct in classrooms. Among these studies, Roger Bybee's (2009) 5E model stands out, consisting of five phases: engagement, exploration, explanation, elaboration, and evaluation. These five

phases are necessary to form the investigative practices developed in the classroom. According to Roger Bybee (2009), activities of this nature focus on science learning grounded in a clear research orientation; in science classes, students should learn to collect data, communicate using scientific language, know how to use graphs, tables, or other means to present their results, and develop evidence-based arguments.

The study by Pedaste et al. (2015), conducted as a literature review, aimed at clarifying the essential components that should make up the research process. The study presents four stages that characterize the research process, highlighting the elements that constitute a research project and are organized into guidance, conceptualization, investigation, conclusion, and communication (Figure 1).

Figure 1
Research cycle proposed by Pedaste et al. (2015).



Source: Pedaste et al. (2015, p. 56). Note: Translation by the authors (2026).

According to Pedaste et al. (2015), in the context of the inquiry cycle, guidance refers to the process aimed at stimulating students' curiosity through the identification and formulation of problems, thereby enabling inquiries both inside and outside the classroom. Conceptualization involves the formulation or development of the problem. The problems should include research questions and may relate to concepts, theories, socio-scientific issues, or even involve the

relationships between science, technology, and society. Students discuss and formulate hypotheses regarding the issue to be investigated. These hypotheses must be tested during the research phase. During the testing of hypotheses, data is collected and interpreted. Depending on the nature of the problem, data can be obtained through experimentation or exploration, such as through bibliographic sources. In the conclusion phase, students are expected to develop arguments that support their position in answering the research question. In this final stage, the initial hypotheses formulated by the students during the conceptualization phase can be tested (Sodré & Zompero, 2024).

It can be inferred that inquiry-based teaching contributes to reflection and the development of critical thinking, as it places students in the role of researchers. By formulating questions, raising hypotheses, testing explanations, and constructing arguments, they develop skills that go beyond memorization, that is, they develop logical reasoning, critical thinking, collaboration, and scientific communication (Carvalho, 2018). As Freire (2009) points out, what the student does, thinks, and communicates regarding knowledge is more important than the teacher's transmission of that knowledge.

Baptista (2010) argues that Inquiry-Based teaching meets the demands of a society characterized by the constant presence of science and technology. As such, it represents an educational practice that combines academic learning with citizenship, preparing students to tackle contemporary challenges with autonomy, critical thinking, and social awareness.

EDUCATION AND HEALTH LITERACY

Health Education (HE) has been establishing itself as a multifaceted field situated at the intersection of the health sciences and the social sciences, where diverse understandings of health and education converge, characterized by different political-philosophical perspectives on the world, human beings, and society (Schall & Struchiner, 1999; Nascimento, 2020; Nogueira et al., 2022).

According to the World Health Organization (WHO), health literacy is defined as 'any combination of learning experiences designed to help individuals and communities improve their health by increasing knowledge, influencing motivation, and improving health literacy' (WHO, 2021a, p. 18, our translation). The WHO defines health literacy as 'the ability to access, understand, evaluate, and use information and services to promote and maintain good health and well-being' (WHO, 2024).

According to Sorensen et al. (2012), health literacy involves the fundamental skills of accessing, understanding, evaluating, and applying information in three health domains: health care, disease prevention, and health promotion. That is, in the domain of health care, individuals must be able to access information on medical or clinical issues, understand, interpret, and evaluate this information, make informed decisions about clinical issues, and follow medical advice. The domain of disease prevention, on the other hand, involves the ability to access, understand, and derive meaning from information about health risk factors in order to interpret and evaluate that information and make informed decisions about disease prevention. In the health promotion domain, individuals must

regularly update their knowledge of the social, economic, and environmental factors that determine health in the social and physical environment; understand, derive meaning from, interpret, and evaluate this information; and use it to make informed decisions about the factors that determine health.

The competencies listed by Sorensen et al. (2012) are summarized in Table 1.

Table 1
Skills applicable to the health sector

	Access	Understand	Evaluate	Apply
Health care	Ability to access medical or clinical information	Ability to understand medical information and derive meaning from it	Ability to interpret and evaluate medical information	Ability to make informed decisions based on medical information
Disease prevention	Ability to access information about health risk factors	Ability to understand information about risk factors and derive meaning from it	Ability to interpret and evaluate information about health risk factors	Ability to make informed decisions about health risk factors
Health promotion	Ability to stay informed about the determinants of health in the physical and social environment	Ability to understand information about the determinants of health in the physical and social environment and derive meaning from it	Ability to interpret and evaluate information about the determinants of health in the physical and social environment	Ability to make informed decisions about the determinants of health in the physical and social environment

Source: Sorensen et al. (2012), adapted by the author (2026).

The WHO publication, which followed Sorensen's (2012) work, points out that to develop the ability to live in harmony with and transform the environment in a way that promotes health, people must develop 'personal, interpersonal, cognitive, and physical skills,' which include decision-making and problem-solving, creative and critical thinking, communication skills, and interpersonal skills (WHO, 2021a, p. 31, our translation).

Nutbeam (2000) proposes three levels of health literacy in terms of skills, autonomy, and engagement: basic/functional health literacy; interactive/communicative health literacy; and critical health literacy. Basic/functional health literacy involves basic reading and writing skills, as well as the understanding and application of knowledge about health and disease in daily life, such as following medical prescriptions and participating in health

programs. Communicative/interactive HE, on the other hand, involves cognitive and social skills that enable individuals to discern, interpret, and apply information independently, as well as to communicate this information in interactions with different groups, thereby potentially influencing social norms. Finally, critical health education pertains to even more advanced cognitive and social skills, which provide the ability to critically analyze the information received and use it to exercise greater control over individual and collective health, including engagement in collective actions regarding the social, economic, and environmental issues that affect health.

The levels of health literacy have different characteristics in health education. The first level results from health education based on the transmission of information about health risks and the health care system. The second level reflects health education focused not only on the transmission of information but also on the development of skills, motivation, and self-confidence aimed at autonomous action based on that knowledge. The third level results from HE centered on the economic, environmental, and social determinants of health, as well as on the development of cognitive, research, and communication skills, aimed at empowering individuals and communities to act on the determinants of health (Nutbeam, 2000).

HE acts as an intermediary factor in the relationship between individuals' socioeconomic conditions and health inequities. In this sense, working to develop citizens' health literacy, with a focus on the critical level, may prove to be a key strategy for mitigating the effects of living conditions on the population's health (Stormacq, Van den Broucke & Wosinski, 2019; Nutbeam & Lloyd, 2021).

According to the WHO, health literacy (HL) should be incorporated into health education (HE) programs in schools, as it can reach a large audience of young people, contributing to positive health outcomes for the population and society (WHO, 2021b). In this sense, HE should have as its primary objective the development of citizenship, resulting from the construction of knowledge and the development of the ability to reflect upon, understand, and critically analyze the world and its relationships with nature and society, thereby characterizing a reflective approach to science education based on the principles of scientific literacy (Venturi, 2018; Venturi & Mohr, 2021a, 2021b; Venturi & Iared, 2022). According to Venturi (2018), reflective health education shares similarities with social health education, particularly regarding the goal of training citizens to manage their own health by addressing social and environmental factors.

However, health education (HE) conducted within the traditional Brazilian school setting has followed a normative approach. Normative HE relies on strategies for conveying information about diseases and how to prevent them, guided by behavioral objectives, that is, on students adopting behaviors considered healthy, based on a view of health reduced to the individual's organs and systems that neglects the social, environmental, and economic factors, among others, that determine individuals' health status (Venturi & Mohr, 2021a).

Considering this and given the potential of inquiry-based teaching to foster critical thinking and reflection, we believe that this approach can serve as an alternative to traditional health education, contributing to the promotion of scientific literacy and critical health literacy through health education carried out in science classrooms.

THEORETICAL APPROACHES AND EDUCATIONAL IMPLICATIONS

In this section, we seek to identify the connections between levels of health literacy, reflective tendencies, and inquiry-based teaching. To this end, it is important to note that inquiry-based teaching promotes the development of higher-order cognitive skills (Zoller, 2000, 2012). The author argues that these skills are related to solving unfamiliar problems, the ability to make connections, and evaluative thinking, which can be fostered by practices that require more sophisticated intellectual activity on the part of the student. Thus, Gatti (1997) defines cognitive skills as generalized actions that assist an individual and transform their attitude in challenging situations. Therefore, cognitive skills facilitate changes in an individual's actions by helping access information and contributing positively to learning experiences (Primi et al., 2001). In this regard, Pinto, Anastácio & Martins (2022) support this view by stating that cognitive skills are related to the mental processes involved in the acquisition, processing, and use of information, including abilities such as attention, memory, reasoning, and decision-making, which are fundamental to the adoption of healthy behaviors.

Concerning scientific education and literacy, Küll (2018) states that the cognitive skills required for scientific literacy are grounded in scientific knowledge and practice across conceptual, procedural, and attitudinal dimensions. The author adds that this approach facilitates the development of civic education, autonomy, and critical thinking. Examples of cognitive skills for scientific education include: reading and writing information relevant to daily life; observing phenomena in their surroundings; memorizing concepts; solving exercises; identifying problems; proposing hypotheses and then seeking to confirm or refute them; collecting and analyzing data and information; discussion, communication, and attribution of meaning; decision-making (Zoller, 1993, 2000, 2001; Suart & Marcondes, 2008; Zompero & Laburú, 2011; Carvalho, 2018).

The 2015 Incheon Declaration (organized by UNESCO) in South Korea aimed to ensure quality, inclusive education with a humanistic vision between 2015 and 2030. The document asserts that education enables the promotion of skills, values, and attitudes that allow citizens to lead healthy lives and make decisions based on the information to which they have access (UNESCO, 2015).

The considerations presented here make it possible to explore certain connections and links between the potential of inquiry-based teaching and the pursuit of health literacy, through educational efforts aligned with the most critical trends.

Returning to the levels of literacy and their dimensions, according to Nutbeam (2000, 2008), the first level refers to skills that enable students to read and write about health-related information. We believe that inquiry-based teaching can contribute to these skills. However, we acknowledge that the use of inquiry-based practices can lead students to go beyond the basic and functional competence proposed at this level by the aforementioned author. However, during the orientation phase proposed by Pedaste et al. (2015), students may have access to information, as well as at the moment they are presented with the problem, that is, the conceptualization phase. There is also a relationship that can be considered regarding engagement as one of the requirements for health literacy. Although Pedaste and his colleagues do not mention engagement as

necessary for students to participate in the investigative process, this characteristic is emphasized by the National Research Council (2000, 2012), as they view student engagement as a fundamental element of work with inquiry-based practices.

At the second level of health literacy, known as the interactive or communicative level, it is possible to establish some more precise connections. Nutbeam (2000) explains that this level refers to the ability to obtain information from various sources and to participate in daily life regarding health-related matters. Sorensen (2012) supplements this information by identifying, as one of the domains of health literacy, the individual's ability to access, interpret, and evaluate information, which corresponds to the dimensions of access, comprehension, and evaluation.

In this regard, the connection that can be drawn with level two is with the orientation phase proposed by Pedaste et al. (2015). Thus, in the orientation phase, it is possible to contextualize scientific knowledge through discussions and interactions with students; for example, by bringing into the classroom problems stemming from socio-scientific issues, such as fake news, the use of pesticides, reading labels and nutritional tables, vaccination, the use of antibiotics, and problems caused by smoking. Contextualization enables students to understand how this information applies to their daily lives, while also helping them make sense of the problem.

At the third level, it can be inferred that the strongest link to inquiry-based teaching exists, since, according to the author, this level refers to more advanced cognitive skills that enable critical analysis of information in order to exercise greater control over life events and situations and make conscious decisions.

Thus, it can be said that during the conceptualization phase of inquiry-based teaching, when students engage with the problem and formulate hypotheses, they are challenged to analyze information, consider different possibilities, and evaluate evidence, which can contribute to this level of literacy. Regarding the problem presented to students, which serves as the trigger for the investigative process, Cruz-Gusmán, Carmona & Criado (2017) argue that questions should be contextualized, meaningful to students, clear in terms of what is to be investigated, and accessible so that they are formulated at the students' cognitive level.

From this perspective, we find another possible connection between level 3 literacy and the investigation phase described by Pedaste et al. (2015). According to these researchers, at this stage, students can test hypotheses through exploration or direct investigation in the process of gathering information. Thus, they can obtain information from a variety of sources, interpret it, and derive meaning from it. Level three also refers to the communication of information (Nutbeam, 2000, 2008). To encourage the process of communicating information derived from the inquiry phase, another connection can be found between this level and the conclusion phase of inquiry-based teaching.

Emphasis is placed on reasoning and critical thinking, which are necessary for students to achieve level three of health literacy. This is made possible by HL, as it encompasses the entire investigative process.

The relationship between HL and levels of health literacy is summarized in Table 2.

Table 2:
Approaches between inquiry-based teaching and levels of health literacy

Level of health literacy	Stages of Inquiry-Based Teaching	Characteristics of the inquiry stage	Relationship with the level and scope of literacy
Level 1	Guidance	Contextualizing Scientific Knowledge	Engagement
	Conceptualization	Problem	Access to information
	Inquiry	Data Collection	Access to information
Level 2	Guidance	Contextualizing Scientific Knowledge	Understanding and practical application of everyday information, relevance to the problem
Level 3	Conceptualization	Problem-posing and hypothesis-forming	Analyze information, consider different possibilities, and evaluate evidence
	Inquiry	Testing hypotheses through exploration or investigation	Ability to interpret and evaluate information
	Conclusion	Argumentation Communicating the results of the investigation and presenting arguments	Informed decision-making

Source: Prepared by the authors (2026).

Based on the above, it is possible to identify commonalities between the components of inquiry-based teaching and levels of health literacy. Thus, it can be argued that inquiry-based teaching and its application in the classroom, through investigative activities related to health-related topics, can promote higher levels of health literacy by fostering the development of higher-order social and cognitive skills such as problem-solving, the ability to make connections, and evaluative thinking, thereby supporting informed decision-making regarding health-related issues.

FINAL REMARKS

Inquiry-based teaching should be understood as a pedagogical approach that reflects the nature of science and promotes scientific literacy. By bringing students closer to scientific practice, it promotes learning that fosters an understanding of how scientific knowledge is constructed, facilitates the development of critical thinking skills, and prepares citizens to understand and engage with scientific and technological issues that affect their lives and society,

as well as health-related matters. Thus, inquiry-based teaching is, essentially, teaching for scientific citizenship.

The demands of today's society call for the education of students who are more committed to understanding the implications of science and technology for society, the environment, health, and well-being, as one of the Sustainable Development Goals (SDGs). Thus, quality education, as also expressed in the SDGs, enables students to access information, but more importantly, to interpret, evaluate, and apply it, and to reflect on it in order to make informed decisions—not only on an individual level but also about the collective.

The discussions and convergences between inquiry-based teaching and literacy levels presented in this study point to a possible and promising relationship between the use of inquiry-based activities—as part of inquiry-based teaching—and higher levels of health literacy, which is a goal of citizens' and scientists' education.

In a world where social, political, and economic decisions are increasingly linked to science and technology, inquiry-based teaching serves not only as a teaching approach but also as a practice that enables students to develop both scientific literacy and health literacy.

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