

**LEARNING COMPETENCES FOR SCIENTIFIC LITERACY IN HEALTH:
POTENTIALS AND LIMITATIONS IN AN EDUCATION IN PROFESSIONAL
SCHOOL**

**COMPETÊNCIAS CURRICULARES PARA O LETRAMENTO CIENTÍFICO EM
SAÚDE: POTENCIALIDADES E LIMITAÇÕES EM UMA INSTITUIÇÃO FEDERAL
DE EDUCAÇÃO PROFISSIONAL**

**COMPETENCIAS CURRICULARES PARA LA LITERACIA CIENTÍFICA EN SALUD:
POTENCIALES Y LIMITACIONES EN UNA ESCUELA DE EDUCACIÓN
PROFESIONAL**

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ABSTRACT: This research aims to analyze the insertion of Scientific Literacy (SL) in health education in Integrated Technical High School Curriculum of Federal Institute of Brasília (IFB, Portuguese initials) using documentary analysis and content analysis technique to evaluate. The skills related to scientific literacy for health practices were researched in natural science subjects in seventeen pedagogical plans of integrated technical high school courses of IFB. Five course plans do not have competences related to scientific literacy for health education. The others contain competences that were categorized in that way: 1. Relation Health/Environment; 2. Health Maintenance Strategies; 3. Technological Progress and Health; 4. Health, policy, and culture. It was found that the insertion of these categories in integrated technical high school curriculum of IFB aims to promote a citizenship education through literacy strategies that are first provided in course planning and then materialized in daily school.

KEYWORDS: Scientific literacy. Health education. Integrated high school.

RESUMO: A pesquisa apresentada no presente trabalho teve como objetivo promover a análise acerca da inserção do letramento científico focado na a educação em saúde nos currículos dos cursos técnicos integrados ao Ensino Médio do Instituto Federal de Brasília (IFB), para coleta de dados utilizou-se análise documental e para a avaliação optou-se pela técnica de análise de conteúdo. Pesquisou-se as competências relativas ao Letramento científico de caráter prático em saúde presentes nas componentes de ciências da natureza nos dezessete planos pedagógicos dos cursos técnicos integrados ao Ensino Médio do IFB. Cinco planos de curso não apresentaram competências relativa ao LC para o ES. Os outros doze apresentaram competências que foram categorizadas da seguinte maneira: 1. Relação

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saúde/ambiente; 2. Estratégias de manutenção da saúde; 3. Avanços tecnológicos e saúde; 4. Saúde/Políticas e sociocultural. Verificou-se que a inclusão destas categorias de temas no currículo dos cursos técnicos integrados ao EM do IFB procura convergir para a formação cidadã através de estratégias de letramento que, primeiramente, são previstas no currículo dos cursos e depois materializadas no cotidiano escolar.

PALAVRAS-CHAVE: *Letramento científico. Educação em saúde. Ensino médio integrado.*

RESUMEN: *La investigación que se presenta en este trabajo tiene como objetivo promover el análisis sobre la inserción de la literacidad científica (LC) centrada en la educación en salud (ES) en los currículos de los cursos técnicos integrados a la enseñanza secundaria del Instituto Federal de Brasilia (IFB). Para la recopilación de datos, se utilizó el análisis documental y para la evaluación se optó por la técnica de análisis de contenido. Se investigó las competencias relacionadas con la literacidad científica de carácter práctico en salud presentes en los componentes de ciencias de la naturaleza en los diecisiete planes pedagógicos de los cursos técnicos integrados a la enseñanza secundaria del IFB. Cinco planes de curso no presentaban competencias relacionadas con la LC para la ES. Las otras doce presentaron competencias que fueron categorizadas de la siguiente manera: 1. Relación salud/ambiente; 2. Estrategias de mantenimiento de la salud; 3. Avances tecnológicos y salud; 4. Salud/Políticas y sociocultural. Se constató que la inclusión de estas categorías de temas en el currículo de los cursos técnicos integrados a la enseñanza secundaria del IFB busca converger hacia la formación ciudadana de los estudiantes, mediante estrategias de literacidad que, primeramente, son previstas en el currículo de los cursos y luego se materializan en el cotidiano escolar.*

PALABRAS CLAVE: *Literacia científica. Educación en salud. Escuela secundaria técnica.*

Introduction

The term Scientific Literacy (SL) has been widely used among researchers and teachers working in Science Education (CUNHA, 2017; AYALA, 2016; CERATI, 2014; FEINSTEIN, 2010; SANTOS, 2016; among others). Many of the laws regarding the formation of the school curriculum, especially regarding the knowledge of the natural sciences, have been built with a focus on teaching and learning processes that promote a level of mastery of scientific knowledge that can be characterized as literacy. A recent example is the publication of the National Common Curricular Base for Basic Education (BRASIL, 2017).

The process of scientific literacy becomes even more important when dealing with issues sensitive to the population, such as individual and collective health, for example. Efforts to promote teaching strategies with a focus on scientific literacy are important especially in the current context, which, with the advent of social networks, is characterized by the increase in what is conventionally called fake news. This type of information requires a great capacity to

analyze reality and contextualize what is read and heard with what is true. This is a global problem, but especially serious in matters related to health, since it builds reluctances towards the efficiency and seriousness of scientific work, especially in the medical sciences (MONARI; BERTOLLI FILHO, 2019).

Despite this important process, debates about the concept of scientific literacy have been taking place around a term still under construction. The use of the concept of scientific literacy occurred for the first time in the 1950s and has undergone changes in understanding since then, with no specific definition or consensus among scholars on the subject. According to Ogunkola (2013), although this consensus has not yet been built, some dimensions are essential for understanding what scientific literacy is. In the first dimension, called nominal literacy, the student would be able to identify scientific terms and issues, but would represent topics, problems, information, knowledge or understandings about science incorrectly. In addition, at this level of literacy, representations of misunderstandings related to scientific concepts and processes tend to emerge. Generally, the person with this level of literacy provides insufficient and inadequate explanations of scientific phenomena. Thus, it is considered that the student makes naive use of science. The second level, called functional literacy, would be one where the student is described as someone capable of using scientific vocabulary properly, defining scientific terms correctly and memorizing technical words, that is, here lies the domain of scientific literacy, however there is difficulty in contextualizing it. In the Conceptual and Procedural scientific literacy, the student understands conceptual schemes of science, the processes of scientific production and the relations between the parts of a scientific discipline. At the last level, called Multidimensional Scientific Literacy, the individual is able to understand the qualities of science and the differences of other knowing and knowledge, recognizing its history and the nature of scientific disciplines, in addition to being able to understand science in its social contexts.

In addition to Ogunkola, Shamos (1995) presents another way of analyzing the stages of SL. The author states that Scientific Literacy is the ability to understand scientific knowledge, the scientific way of thinking, its research and analysis strategies and the way in which scientific models are constructed. For Shamos, the SL consists, therefore, in the domain of scientific language, although this refers not only to the domain of vocabulary, but, mainly, its use for social purposes.

In the context, scientific literacy could be classified into 3 categories: a. Scientific Literacy of Civic Order; B. Scientific Literacy of Cultural Order and c. Scientific Literacy of Practical Order (SHEN, 1975), being the third category that would lead to a citizen education

of students and on which this research was developed. Here it was also intended to carry out a curricular analysis, therefore, it is essential to discuss the concept of curriculum to which this analysis is linked, since the curriculum is intimately connected to the conception of man and society that is intended to be built from the teaching and learning processes arising from the formative model.

In this sense, it is important to raise initially that since ancient times man has been using, in educational processes, organized disciplinary sets and activities oriented in a systematic way. However, the word curriculum, in the scope of education, was only inserted in more recent periods and appears in conjunction with the separation of students into classes (HAMILTON, 1992) and with the process of compartmentalization of knowledge, very present in Galilean science, which it is characterized by the understanding that science is an autonomous process and that it ends in itself and that disregards the subjects involved creating, from this process, unequivocal categories (CASTORIADIS, 1997).

From the point of view of the etymology of the term, the word curriculum is associated with the Latin term *curriculu*, which refers to a race track. Silva (1999) reanalyzing the term in his studies points out that, in this race, we ended up becoming what we are. Curriculum scholars who work in the critical perspective understand that, in this construct, numerous tensions are involved regarding the issues of power in their process of construction and execution of curricular structures (FREIRE, 1975; 2000; CORTELLA, 1998; CURY, 2000; MÉSZÁROS, 2005). Others point out their contributions specifically on the analysis of curricular structures (APPLE, 2006; GIROUX, 1987; SACRISTÁN, 1998; 1999; 2002).

Sacristán (1999, our translation) states that "*the curriculum becomes a kind of text whose pretension is the reproduction of a way of understanding reality and the processes of social production that it must serve*". However, Sacristán argues that between the contexts of formulation and that of realization, there is the intervention of several agents. In this sense, the school and the teachers do not teach culture or knowledge in the abstract, but reconstructions of them, inscribed within institutions and daily practices (SACRISTAN, 1999).

With regard to the integrated curriculum developed within the scope of vocational formation courses, Ramos (2009) points out that for the integration process between technical and basic formation (given in traditional secondary education) to be fully carried out, it is necessary that three main and complementary dimensions are satisfied: the integration between the dimensions of human formation (science, work and culture); the integration between high school formation and technical formation for a professional performance; and the integration of teaching practices, in the sense of interdisciplinarity and joint work.

As part of the curricula for the education of children and adolescents in Brazil and around the world, including in professional education, Health Education is built from different conceptions arising from health and education and is in a constant process of construction/reconstruction. Health Education has received many political and philosophical contributions over time, constituting itself as an intervention/interaction process on the individual or on a group of individuals, in order to produce in them the prerequisites for the development of choices that guarantee the acquisition and maintenance of health. Despite its importance, Health Education has been developed, in many cases, in a prescriptive, biologic and hygienist perspective, in which the complexity of human action and the possibilities for reflection and feedback characteristic of societies are disregarded (VENTURI; MOHR, 2017).

A large part of the Health Education actions is associated with the debate on topics such as the use of drugs and medicines, sexuality and sexually transmitted diseases, uses and resistance to vaccination and, also, food and relations between health and the environment. From a theoretical point of view, Health Education is understood as the educational process of building knowledge for the appropriation of the theme by the population as a whole, seeking to increase the autonomy of individuals in self-care (FALKENBERG, 2014). Finally, Health Education also consists of the production and systematization of knowledge related to formation and development for health care, involving teaching practices, didactic guidelines and curriculum guidance (BRASIL, 2018).

For Health Education to reach the ends presented here, it is recommended that it be part of the school routine, inserting itself and contextualizing itself in this environment, as this way the knowledge necessary for a healthier way of life will be developed permanently and will last both in the school and outside (MAINARD, 2010).

In view of the ideas presented here, this research aimed to analyze the possible insertion of competences aimed at scientific health literacy in the curricula of technical courses integrated to high school at the Federal Institute of Brasília (IFB), Brazil.

Methodology

In this investigation, qualitative research strategies were chosen. According to Yin (2016), qualitative research is a field of investigation that is characterized mainly by analyzing processes related to the existence of individuals as social beings, capturing, through appropriate techniques, the views, concepts and perspectives of the various facets of human life. In the investigative processes associated with qualitative research, the contexts in which the

investigated are inserted are considered, in addition to the phenomena that may, possibly, influence their choices, which is the case of the formation of school curricula.

Qualitative research can also be understood as one that considers the interrelationships between individuals participating in the investigation and the reality in which they are inserted, since they are inextricably linked, making it difficult to separate the world (objective) from the subject (subjective), a relationship that cannot be measured numerically. In this type of research, the interpretation of phenomena and the attribution of meanings to them are the basic objective of the investigation (KAUARK *et al.*, 2010).

In view of the above and based on the understanding of Curriculum as a historical artifact and considering the characteristics of Health Education and Scientific Literacy, data collection was chosen for documentary analysis (KAUARK; MANHÃES; MEDEIROS, 2010). For the evaluation of the collected data, the content analysis technique was chosen (BARDIN, 2011).

Content Analysis was systematized by Bardin in his book *Analyse de Contenu* in 1977. According to Bardin (2011), the expression content analysis refers to:

A set of communication analysis techniques aiming to obtain, by systematic and objective procedures for describing the content of messages, indicators (quantitative or not) that allow the inference of knowledge related to the production/reception conditions (inferred variables) of these messages (BARDIN, 2011, p. 47, our translation).

This analysis strategy seeks to understand the characteristics, structures or models inserted in the messages produced in the most diverse forms of communication. Content analysis, enhanced by Bardin, consists of three main steps: 1. Pre-analysis; 2. Exploration of the material; and 3. Treatment of results - inference and interpretation (CÂMARA, 2013).

The **pre-analysis** consists of reading the material obtained at the data collection stage. It is carried out, generally, through a fluctuating reading of interviews or reports produced by the analyzed group. In this reading, it is necessary to observe points of convergence in the discourses produced, as these will be used in the next phase, in the elaboration of the analysis categories (SILVA, 2005).

In the exploration of the material, the coding units that will result in categories are established, which must be associated with the speeches that justify them. They can be chosen to establish these categories, words, expressions and lexicons from which the records can be grouped. The data must be organized in tables that will be filled with columns containing the elaborated categories and excerpts from the speeches obtained during the collection period. The

last category refers to the treatment of results - inference and interpretation. In this stage, with the established categories and linked speeches, the researcher starts to elaborate the propositions and concepts that were obtained in the previous stages and, finally, the data interpretation, where based on the previously chosen theoretical framework, the researcher interprets the data making inferences, comparing with other studies in the same sense, movement from which the researcher will form his conclusions about the studied phenomenon (CÂMARA, 2013).

Based on these ideas, a sample was made up of a total of fifteen pedagogical plans for technical courses integrated to IFB's professional formation. In them, the curricula of the disciplines of Natural Sciences were analyzed, in which it was expected to identify the presence of competences directed to the formation of scientific literacy for topics related to health.

Results and discussion

In this research, the seventeen pedagogical plans of the Technical Courses Integrated to High School of the Federal Institute of Brasília were analyzed in order to identify possible competences related to scientific literacy, of a practical nature, in the curricular components of Natural Sciences.

Of the plans evaluated, five did not have skills related to Health Education. The other 12 had such skills that were categorized as follows:

Table 1 – Categorization of Content Analysis of Health competences in Pedagogical Projects of Technical Courses Integrated to High School of IFB

Category	Subcategory	Indicator
	Health/environment relationship	<p>PC.6: “Understand the importance of controlling and monitoring the environment, using appropriate techniques, in order to preserve natural resources and ensure the health and well-being of the population.”</p> <p>PC.8: “Understanding interactions between organisms and the environment, in particular those related to human health, relating scientific knowledge, cultural aspects and individual characteristics.”</p> <p>PC.11: “Identify the risks related to the environmental factors that determine and determine diseases and other health problems; To stimulate the interaction between health, environment and development, aiming at strengthening the participation of the population in promoting health and quality of life.”</p> <p>PC.3: “Recognize that the conditions of food, education and the environment, among others, are determining factors of individual and collective health.”</p>

Curricular Competence in Health		PC.12: “Recognize that the conditions of food, education and the environment, among others, are determining factors of individual and collective health.”
	Health maintenance strategies	<p>PC.1: “Understand means and attitudes to promote and preserve health”; “Understand the etiological aspects of diseases caused by infections and aspects of collective health”; “Recognize the various types of drugs and the harm to health caused by their use, relating the effects suffered by the human organism.”</p> <p>PC.2: “Recognize the various types of drugs and the harm to health caused by their use, relating the effects suffered by the human body.”</p> <p>PC.3: “Encourage dialogues and interventional actions on public health and the prevention of diseases related to the work environment.”</p> <p>PC.4: “Reflect on the functioning of the human organism, in order to adopt an autonomous posture of selection of activities and procedures in the maintenance and acquisition of health.”</p> <p>PC.5: Relate basic sanitation to human health in different Brazilian regions.</p> <p>PC.9: “To value knowledge about the structure and functioning of the organ systems of the human body, recognizing them as necessary both for the identification of possible organic disorders and for the care with the maintenance of one's own health”; “To know dietary supplements, anabolic-androgenic steroids and metabolic accelerators, their functioning and health effects”.</p> <p>PC.8: “Evaluate proposals of individual or collective reach, identifying those aimed at preserving and implementing individual, collective or environmental health”.</p> <p>PC.10: “Understand the importance of nutrients in the formation of cells and in maintaining health”.</p>
	Technological advances and health	PC.5: “Recognize the health and food production benefits of biotechnology”
	Health and Politics/Sociocultural	<p>PC.1: “Build the notion of health taking into account biological conditions such as sex, age, genetic and social factors, economic, environmental and cultural factors such as income level, education, lifestyles, nutritional status, possibility of leisure, quality of transportation, sanitation conditions.”</p> <p>PC.6: “Identify, analyze and discuss vulnerabilities linked to the contemporary experiences and challenges to which young people are exposed, considering the physical, psycho-emotional and social aspects, in order to develop and disseminate prevention and health and well-being promotion actions.”; “Evaluate and/or promote actions that contribute to the improvement in the quality of life and health conditions of the population”.</p> <p>PC.7: “Adopt attitudes that promote the permanent expansion of quality of life, recognizing health as a human aspect that involves biological, political, economic and sociocultural</p>

		issues”; “Reflect on the role of hygiene strategies for maintaining general health”.
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Caption: PC - Course Plan

Source: Devised by the authors. Our translation

In the category **1- Health/environment relationship** - the competences that seek to build with students the ability to relate problems and health and the health/disease relationship with changes in the environmental balance can be inserted. Previous studies have pointed out the need for a holistic look at the relationship between health and the environment, as there is an interrelation between them arising from the impossibility of separating man from the natural environment. (LEFF, 2001; BRAGA *et al.*, 2007; NEGRETE *et al.*, 2010).

In this sense, in a study carried out in the curricula of undergraduate courses in the areas of health, Souza and Andrade (2014) evaluated that the incorporation of environmental issues and their relations with health policies, in addition to the analysis of environmental health objectives, appeared to be relevant in the formation of future health professionals, especially when thinking about the need to foster in students the perception that their individual existence is part of a natural environment. In this process, it is possible that, through this formation, the student will be able to point out the interrelationships between man and nature, the reciprocity relations between the components of the natural world, including the human species, placing it as a constituent element of the environment and not apart from him.

In category **2- Health maintenance strategies** - competencies are inserted that have as their main characteristic the intention of promoting/maintaining health. Most of the time these skills are related to a biologist bias in health education and lead to references of this type of educational action in Brazil. Biologist bias is understood as an approach to health education focused exclusively on biological issues of the health/disease relationship. An idea that only knowledge about how species and their relationships work would be sufficient to establish a state of health. Although Health education has changed, this is still the main approach to health education developed in school spaces, mainly in the curricular components of natural sciences (SILVA; TEIXEIRA; FERREIRA, 2012).

Monteiro and Bizzo (2015), in a research that analyzed the history of the insertion of themes related to health maintenance in school curricula, point out that, despite the incipient presence of health education in the official documents of Brazilian education over the last 40 years, the advances and changes in the understanding of the concept on the theme in public educational policies are notorious. The authors also suggest that curricular documents abandon

the prescriptive character of higher education, providing students with the appreciation and use of the peculiar characteristics of the societies in which they operate, a measure that can only be adopted when the curriculum is designed based on the social reality where it will be carried out.

The category 3- Technological advances and health - comprises the skills that have, among those analyzed, the greatest potential from the point of view of scientific literacy. The appreciation of the results of scientific production and technology had a significant increase in the 20th century, so that today it is unthinkable to work in health education without considering the technologies, many of them of an innovative character (SOUZA, 2016).

Martins (2019), reflecting on the possibilities of articulating health education, points out that one of the effective ways to promote a sustainable and significant HE is its integration with the study of scientific and technological advances. The author also states that a more integrated and critical execution of health issues in school curricula occurs when it is carried out with the inclusion of discussions about technological advances and, with the incorporation of the social determinants of these advances, which can be obtained when health education is approached from the perspective of Education for Science-Technology-Society (STS).

The category **4- Health and Politics/Sociocultural** - refers to the contextualization of health education and is based on the concept of education as a process that involves action-reflection-action. Educational competences with this characteristic show the need for an educational formation that aims at concrete, cultural, political and social action based on pointing out conflicting situations in everyday life, the perception of contradictions in the social context and actions to overcome them (FREIRE, 1987).

Nespolo and collaborators (2014) analyzed the work in health education associated with popular education through the Points of Culture. From this process of action and reflection, the authors raised that the association between HE and social and cultural issues, in these Points, constitutes a strategy to amplify the dialogical work, where those involved are agents of mobilization of health issues. In this process, knowledge, experiences and emotions are valued. Through this health education model, it is possible to enhance popular involvement in actions aimed at promoting individual and collective health, which increases collective participation and bonds of solidarity in the community (NESPOLO *et al.*, 2014).

In view of the data found in the curricula of the Integrated Technical courses of the IFB, it was found that the inclusion of these categories of themes in the formation of students is characterized as a way of stimulating citizen formation, through literacy strategies that are first provided for in the curriculum of the courses, materialized in the school routine and, hopefully, materialized in the healthier choices in the students' routine.

Final considerations

The analysis of the curricula of the Integrated Technical Courses of the Federal Institute of Brasília, with regard to the inclusion of themes that have the potential for the development of scientific Literacy in health, reflects a concern and an attempt to emphasize the importance of the theme for the formation of adolescent students who often need to make decisions about drug use, sexual behavior and psychological health, for example.

From this process, it appears that, in line with the official curricular guidelines of Brazil, the theme is inserted in most of the institution's courses, however, there is a need to add this debate to five course plans.

Of the plans where the debate on health is already foreseen, some have greater potential for practical literacy, which is necessary for the development of a more effective health education with better results. In these plans, health education is related to sociocultural reflections, decreasing the biological and hygienist character that we often find in Health Education.

Based on the information obtained in this study, the belief is that it is necessary to carry out research aimed at verifying the ways in which this curricular information is materialized in the classroom, that is, the practices actually developed in the daily lives of students and teachers, in addition to the effective contributions that this debate brings to the promotion of students' health and life.

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