


## THE CONNECTION BETWEEN THE TEACHING OF SCIENCE, TECHNOLOGY AND SOCIETY IN THE CONSTRUCTION OF KNOWLEDGE IN NATURAL SCIENCES

 <https://doi.org/10.56238/arev6n4-127>

Submitted on: 10/11/2024

Publication date: 10/12/2024

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### ABSTRACT

The discussions about the concepts of History, Science, Technology and Society for the problematization of the Teaching of Natural Sciences, found advances on the contributions of Technological Education to Technological Education in the face of the conceptions of contemporary society. The article aims to bring a reflection on the connections between the teaching of science, technology and society from scientific knowledge to the construction of knowledge around Natural Sciences in the school context. The narrative construction occurs through a literature review that seeks to discuss through scientific studies and official documents that support the integration of objects with the perspective of the construction of scientific, technological and social knowledge. The result of the research shows that the construction of a propaedeutic school curriculum base, accessible and focused on the

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development of a critical, reflective and protagonist individual, provides necessary subsidies for the construction of scientific and technological knowledge for the benefit of society.

**Keywords:** Teaching, Science, Technology, Society.

## INTRODUCTION

Science, in common sense, emerged to explore the sciences of things. In the beginning, the junction between scientific knowledge and technique was something different in the eyes of some scientific philosophers, called "engineers", providing subsidies for the formulation of concepts about technology.

In the history of Science, Ana Maria Alfonso-Goldfarb (1994) portrays that science has always been closer to philosophy (logic, epistemology, philosophy of language) than to history, but little by little it has been assimilating, filtering and adapting elements of history that combined with other elements of sociology, anthropology and various human sciences, being a factor of agglutination between science and humanity.

Thus, the history of science articulates different knowledges as a bridge to contextualize the way science is done and how it is presented over time, passing through the contributions of technological teaching to the natural sciences.

But what is science? Defining science is very complex and does not have a concrete definition, however, it presents characteristics through methods and concepts attributed to scientific activities, as stated by Araújo (2015) in his article entitled "What is science after all?", where he presents the ideas elaborated by Chalmers (1993).

In his work, Chalmers (1993) proposes a reflection on what we should do when starting a scientific activity, that is, carry out the observation only for one or several theories, based on one or more methods, taking into account some important characteristics for the production of scientific work, being the resolution of the problem of one of them.

Chalmers (1993) shows that the problems present in scientific activities have methods (inductive, deductive, hypothetical-deductive and others) to be used and rejects "a single scientific method", because, according to epistemologists, there is a methodological pluralism with several ways to do science.

Science and scientific work, in their social context, have a globalized conformity that aims to establish, even if under attempts, generalizations applicable to nature to describe phenomena, make predictions, approach and establish new paradigms. In this way, science is also a social process and is not on the margins of society, influencing and being influenced through social phenomena that, in turn, are related to the way scientific knowledge is produced.

In view of the above, this article aims to bring a reflection on the connections between the teaching of science, technology and society from scientific knowledge to the construction of knowledge of Natural Sciences in the school context.

## **TEACHING SCIENCE, TECHNOLOGY AND SOCIETY**

Science over time has been marked by different philosophical perspectives, gaining different epistemological characteristics, motivated by human curiosities or natural phenomena, relating scientific knowledge to society, in the aspect that leads to learning from science.

Bazzo (1998) conceptualizes science as an inherited conception, an autonomous, objective, neutral enterprise based on the application of a code of rationality alien to any type of external interference.

These activities, developed by scientists in a single paradigmatic model, called by Kuhn (1998) as normal science, aim at confirming and/or modernizing the paradigms accepted in a scientific community. "Normal scientific research is directed towards the articulation of those phenomena and theories already provided by the paradigm." (Kuhn, 1998, p. 45).

In the light of studies on science from a historical perspective, a democratic look is proposed in the face of different contexts, approaches and interpretations of the production of scientific knowledge.

The contributions of the sciences to society praised the conception of scientific knowledge and facts, which have been accumulating over time, indicating a linear path by which science "evolves", as well as the historiography of great peoples and scientists seen as an influence for this evolution.

"The history of Science will thus be an edifying example for young students and a source of pride for scientists. Because, through it, it was possible to know how science won many battles against ignorance, religion and mysticism, its eternal enemies. But as science was the future, this glorious past was falling further and further behind. (Alfonso-Goldfarb, 1994, p. 12)."

Like any transformation, science has also undergone many critical reflections, in the use of scientific knowledge for technological advancement for one's own benefit, idealism or the progress of society.

These non-cumulative scientific achievements, seen by the scientific revolution by Thomas Kuhn (1998), seek to modulate new paradigms.

"[...] paradigms are universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners of a science [...] (Kuhn, 1998, p. 67)."

In this way, groups of beliefs, values and techniques shared by the members of a given community are formed, allowing science to be present at all times and in any economic, social or technological space. Kuhn (1998) states that the sciences, in addition to being human constructions, are, consequently, historical and social constructions - a new understanding, that is, scientific literacy.

## SCIENCE TEACHING

The teaching of Science, in the context of basic education, envisions several ways of transmitting scientific knowledge. As a result, it has been the object of study by several authors such as Bizzo (2008), Chassot (2004) and Vale (2009) among others. In which, in view of history, they bring contributions about this teaching, pointing out the obstacles and possible changes.

The competencies to be developed for scientific knowledge at school are guided by the principles provided for in the National Curriculum Guidelines for Basic Education, added to the National Common Curriculum Base (BNCC). Thus, the teaching of sciences in dialogue with the Base, seeks to promote an intrinsic relationship with the nature of science as an enterprise of human historical, social and cultural construction.

"As defined in the Law of Guidelines and Bases of National Education (LDB Law No. 9,394/1996), the Base must guide the curricula of the education systems and networks of the federative units, as well as the pedagogical proposals of all public and private schools of Early Childhood Education, Elementary Education and High School, throughout Brazil. (Brazil, 2018)."

An important point to be articulated for this significant learning is scientific literacy, in which it proposes applied knowledge that intervenes in the real world based on ethical and sustainable principles, developing in students sufficient skills based on investigative procedures with an intentionality of its use in every area of knowledge of the natural sciences, being a didactic construction that encompasses biological, physical and chemical knowledge.

Based on this principle, the BNCC establishes that scientific literacy:

"[...] throughout Elementary School, the area of Natural Sciences is committed to the development of scientific literacy, which involves the ability to understand and

interpret the world (natural, social and technological), but also to transform it based on the theoretical and procedural contributions of science. In other words, learning science is not the ultimate purpose of literacy, but rather the development of the ability to act in and on the world, important for the full exercise of citizenship. (Brasil, 2018, p. 273)."

The proposal of the curricular base is relevant in the process of teaching and learning of natural sciences in the school environment, in the focus on the scientific and technological evolution of contemporary society, as well as the interrelations historically and socially constructed.

According to Bizzo (2008), the author emphasizes that science classes need to take a new direction, such as modifying the preparation of classes, providing moments of self-reflection to students, offering opportunities to test explanations and reflect on their property, limits and possibilities, are activities that give rise to a very different way of teaching and learning science, giving space to the process of technological teaching.

For this, it is important to take students from the early years to reflections that refer to scientific concepts and knowledge of the construction of explanatory models in their particularities. Vale (2009) points out:

"A Scientific Education should begin from an early age, from preschool, cultivating the curiosity of the child embodied in the insistent why? that, on more than one occasion, has put many parents and many educators in difficult situations. I understand that the child is born with the desire to know the world and that the school "kills" the natural curiosity of children with a poor and outdated teaching far below the needs and interests of young people. (Vale, 2009, p. 14)."

Thus, it is necessary for a scientific education, whether in the natural sciences or other areas of education, a preparation so that the student can be part of scientific and technological advancement, promoting a reflection and criticality of common sense knowledge in more elaborate knowledge.

## **TECHNOLOGY**

Technology is present everywhere and we can say that it is an important part of our lives and we cannot live without it. It is considered a social phenomenon, with this, we can say that primitive peoples also have technology, being the result of collective historical processes.

From this perspective, we are using technology in almost everything we do. We have the perception that if we want to become active members in our society, then we must all have some level of technological education.

Oliveira (2008) states that one of the greatest difficulties encountered today, in the various sectors of society, are the conflicts caused by the influence of technologies, specifically the new communication and information technologies.

Still corroborating, Correia (1999) defines the term technology as a set of organized knowledge and information, coming from various sources such as scientific discoveries and inventions, obtained through different methods and used in the production of goods and services.

In the context of technological education and technological teaching, technology is present in the way we learn and teach. Technology is a human production, and the human being presents himself as the central figure in this production process. And due to the emerging needs of his time, man, based on technology, created instruments and tools that enabled the advancement of humanity, determining his own culture (Lupion, 2004, p. 9).

Based on these reflections, it can be pointed out that technological teaching is permeated by pedagogical actions that aim at a social construction, so that it puts technology in the place of assisting in the teaching and learning process, promoting social interactions.

Gonçalves and Azevedo (2014) propose discussions about technological education and its contributions to the promotion of Technological Education. The authors discuss technological education in three moments: the first deals with the term "education" and who is responsible for providing it to individuals; the second, addresses Technological Education, its characteristics and objectives; the third deals with technological teaching and its contributions to that education.

The school is inserted as one of the stages of the individual's education process, and this environment is often seen by society as the main responsible for such formation (Gonçalves and Azevedo, 2014, p. 2).

The author points out that Technological Education seeks not only to form a level or degree, but also a training that is capable of providing individuals with a critical and reflective look at the issues of the world, without losing sight of the technical knowledge of the tools necessary to enter the world of work.

Teaching would then be a specific action, with the aim of promoting student learning for a certain content to be taught. We realize that teaching is not a simple action, and that it is the teacher's role to form situations contextualized with the reality of the individual to be taught (Gonçalves and Azevedo, 2014, p. 4).

The construction of knowledge through the daily process of investigation, making research a permanent element of innovation in search of solutions to questions, is an important task for technological education.

Thus, we consider technology as a human construction, where its meaning goes beyond the functionality of products, reaching more complex areas and fields of knowledge, such as symbolism. With this, man, through the creation of social, cultural and religious symbols, increasingly seeks to improve himself, placing himself as one of the characters in the process, producing resources for his benefit and improvement in the quality of life (Bazzo, 2010).

## **SOCIETY**

According to Bazzo (1998), society is like one more among different types of systems. Systems can be machines, organisms, psychic systems, and social systems.

The conceptions of society sought to improve their productions in the face of the situated scenario, taking the information in each space or group. Thus, we can say that society is a network of connections that do not occur by chance, it is a reflection of strategies and manifestations that are merely present in the social process.

"Everyone knows what is meant when the word 'society' is used, or at least everyone thinks they know. The word is passed from one generation to another as a coin whose value is known and whose content no longer needs to be tested. When one person says "society" and another listens to it, they understand each other without difficulty. But do we really understand? (Elias, 1994, p. 63)."

In this sense, the author brings a reflection associating society and individual as processes to be studied in their particularities, the time and space experienced in communities must be analyzed, based on their characteristics and evolutions.

In this way, society is composed of a great dynamic, with several symbolic exchanges occurring, creating its own networks and its own configurations.

Thus, the studies evidenced in the civilizing process directly marked the configuration of society and the environment. Since, it is important to take these discussions about the impacts, advantages and disadvantages of this path to educational spaces,

promoting the construction of new knowledge and interaction of scientific and technological elements in social life. According to UNESCO (2005):

"If the importance of science and technology for the economic and social development of the country is indisputable, it is necessary to recognize that among the conditions of this development are quality scientific education in schools; the training of qualified professionals; the existence of universities and consolidated research institutions; the integration between scientific and technological production and industrial production; the search for solutions to serious social problems and inequalities. (UNESCO, 2005, p. 2)."

It is worth reflecting on how society constructs science and its technologies or how science and technologies, created by society, interfere in the functioning of this society itself.

It is important to think about the social construction based on science and technology, being moved by beliefs, ideologies, social classes of scientists who defend the interests of certain groups, with this, the scientist is understood as belonging to the totality of society, and this dynamic of integration of ideas results in the "rhythm" of social development.

Based on Marxist theories, Pinto (2008) exposes two lines of reasoning, which refer to the presence of technology in society. The first is that Man is a technical being and, for this reason, defends technological advances, without considering that technology has always been present in human history, and does not recognize that technique is in the essence of human formation. The second idea points out that, because technique has been a fundamental part of the process of human development, it becomes ontological. Therefore, we must take into account the construction of society, that is, each individual as a "patrimony of humanity".

In this perspective, we emphasize that scientific research and the evidence of technological teaching are the basis for the most diverse discoveries of Science, directly impacting the evolution of society. According to Bazzo (1998).

"The contribution that science and technology have brought in recent years is undeniable. However, despite this observation, we cannot rely excessively on them, becoming blinded by the comfort that their technical apparatuses and devices provide us on a daily basis. This can be dangerous because, in this anesthesia that the dazzle of technological modernity offers us, we can forget that science and technology incorporate social, ethical and political issues. (Bazzo, 1998, p. 142)."

In this way, technology acts as a factor of distinction and consequently of subordination between nations, since the characteristics caused by differentiations are

obtained from the process of maintaining control of technology, which is done by those who have them in their hands.

These social conceptions, in the educational context, seen by the area of Natural Sciences, develop historiographical studies in the students that allow the construction of scientific knowledge, how they used to do it, how it is being done, and how we can do it in its essence.

## CONCLUSION

The importance of the focus on the Teaching of Science, Technology and Society in the area of Natural Sciences is emphasized. Within the proposal of the National Common Curricular Base (BNCC), the relevance of bringing the student closer to the interaction with science and technology in all dimensions of society is perceived, providing him with a broad and social conception of the scientific and technological context. In which, technology is seen as transformation and relationship with the dominion of the human being over nature, regardless of the time and context experienced by the present society.

Bazzo (1998, p. 145) states that "we live in the belief that science translates into technology, technology modifies industry and industry regulates the market to produce the social good".

We consider that Science, Technology and Society are processes arising from social construction, where their meanings have been gradually integrated, that is, cumulative, through scientific and technological knowledge that serve the interests of a class that holds the political and economic power to make the development of society. As Kuhn (1998, p. 173) mentions, "Scientific knowledge has been considered, not as Revolutions, but as additions to scientific knowledge"

In view of what the author has exposed, it is expected that Natural Sciences will discuss the concepts, processes and integration of Science, Technology and Society, seen in the BNCC, as a necessary competence to be addressed in education, bringing a theoretical foundation based on previous and acquired knowledge.

"Citizens deserve to learn to read and understand much more than watertight concepts – science and technology, with their implications and consequences, in order to be able to be a participating element in political and social decisions that will influence their future and that of their children. (Bazzo, 1998, p. 34)."

Thus, the teaching of science, however, the technological and social should permeate the other areas of knowledge, with a focus on meaningful education and citizenship formation, integrating them with economic, ethical and political aspects. This education that encourages "new scientists" to present promising models for a more just, critical and inclusive society.

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