

Astronomical Society of the University of Carabobo: scientific enculturation agent in Valencia city (Venezuela)

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Abstract. The Astronomical Society of the University of Carabobo (SAUC) is an activity of permanent scientific dissemination, which uses Astronomy as a tool for the scientific enculturation of the local population and non-formal teaching of Science and Technology. The SAUC base their Learning activities through the Bachelard epistemology and Morin pedagogy. Furthermore the focus of the dissemination and popularization of Astronomy must focus on knowledge for life and on overcoming epistemic obstacles between knowledge expert and knowledge taught. The SAUC's activities are focused on holding Master Class, seminars, astronomy courses for amateurs; development of multimedia materials and the national astronomical ephemeris. The qualitative evaluation, after two decades of activities of the SAUC allows us to conclude that astronomy can affect as a motivating axis for cultural appropriation and scientific enculturation by broad sectors of the local community, regardless of age, gender, race, socio-economic activity, or ideological-cultural diversity.

Keywords. scientific enculturation, epistemology, history of science

1. Introduction

The regularities of the movement of the stars in the celestial sphere, demonstrated the awareness that the natural world could be rationally understood, that there is an “order” and “rules” that govern it, and that knowledge of them to our most ancient ancestors, allowed the satisfaction of specific needs such as the farming and fishing days. This cultural heritage on the role of astronomy to encourage the study of nature; It is usually used for non-formal education and the dissemination of science and technology. The Astronomical Society of the University of Carabobo (SAUC) is a permanent scientific dissemination activity, which uses Astronomy as a tool for the scientific enculturation of the population, and for the non-formal teaching of Sciences and Technology, in the City of Valencia Venezuela .The SAUC is a permanent scientific dissemination activity, which uses Astronomy as a tool for the scientific enculturation of the population, and for the non-formal teaching of Sciences and Technology, in the City of Valencia Venezuela. The activities of the SAUC consist of the holding of periodic events (scientific fairs, courses and masterclasses, stars parties, convention of amateur astronomers, etc.) and permanent information about news topics of astronomy and Space Sciences (on Radio, TV, newspapers and social networks). The Astronomical Society of the University of

Carabobo began as a permanent activity for the study and dissemination of astronomy at the end of the last century, coinciding with two notable astronomical events in the region. Although there were already groups of astronomy fans in the region, they did not carry out permanent outreach programs. The transit through the perihelion of Comet Hale-Bopp, in April 1997, dazzled the local population, showing itself as the brightest comet of the century and remaining visible to the naked eye for a long time. It gave rise to several days of astronomical observation and continuous interaction with the community. The total solar eclipse February 1998 was, a phenomenon of singular majesty that led us to plan activities outside our geographic environment distant more than 300 kilometers from our city. The logistics carried out for the trip to the zone of totality, allowed us to bring together local astronomy fans. In addition, the interaction with astronomers from other regions, promoted the realization of group activities and use of common resources for the divulgation of astronomy in our country. For more than two decades, this activity has brought together the University Community, the Carabobo State Engineers Center, the Venezuelan Association for the Advancement of Sciences and the Associations of Astronomy amateurs, with the purpose of disseminating science and technology. The non-formal education in astronomy, as a tool for the scientific enculturation of the local population and non-formal teaching of Science and Technology is the propose of SAUC; and the conceptual systematization was present several years ago [Falcon & et al \(2002\)](#) [Falcon \(2009\)](#). Now we present the conceptual connection of the astronomical heritage and popularization of Astronomy with the Bachelard Epistemology and the Morin pedagogy.

2. Overview

The Astronomical Society of the University of Carabobo, following the premise formulated by UNESCO, within the framework of the “Education for a sustainable futurproject, launched in 1996, bases its Learning activities on the cognitive theories of Gastón Bachelard and Edgar Morín, according to which the approach to the dissemination and popularization of Astronomy should focus on knowledge for life and on overcoming epistemic obstacles between expert knowledge and knowledge taught. Bachelard [Bachelard \(2000\)](#), in his work contributes his conception of epistemological obstacle. And he poses it as the psychological difficulties that do not allow the appropriation of knowledge, minimizing the transition from a pre-scientific state to a scientific state, through the observation of phenomena. The Epistemological obstacles , as Bachelard says, can be reduce to the list: (a)The first obstacle: primary experience, (b) General knowledge as an obstacle to scientific knowledge, (c) An example of a verbal obstacle: sponge. On the over-extension of familiar images (d) Unitary and pragmatic knowledge as an obstacle to scientific knowledge, (e)The substantialist obstacle (f) Psychoanalysing realists, (g) The animist obstacle, (h) The myth of digestion, (i) The libido and objective knowledge, (j) The obstacles to quantitative knowledge, and (k) Scientific objectivity and psychoanalysis. In the Scientific Spirit, Bachelard [Bachelard \(2000\)](#) advocates the imitation of the rationalism and values of Science, rather than its methods

Scientific culture must be in a state of permanent mobilization, replace closed and static knowledge with open and dynamic knowledge, dialectize all experimental variables, favoring the evolution of reason. The verbal obstacle prevents the advancement of science. Language plays a preponderant role in the recognition of phenomena, and must be used in a responsible way, the abusing explanations, associations, linguistic subjectivities, puts the act of understanding and the act of communication at risk. The approach to the natural world through phenomenology opens the way to the formation of scientific knowledge in a continuous search for knowledge. Scientific discursive rationalization is opposed to basic convictions such as light certainties. One should not start

Bachelard Epistemology	Movement of the "stars" in the Celestial sphere	Astronomy examples	Morin pedagogy in XXI century
• Foundation	<ul style="list-style-type: none"> • Spatial universality • Temporal regularity • Changes in cycles 	<ul style="list-style-type: none"> • Planetary apparent movement • Celestial dynamics in the solar system • Stellar evolutions • Solar cycles activity 	<ul style="list-style-type: none"> • Blindness: error and illusion • Teach understanding
• Coherence	<ul style="list-style-type: none"> • Rational understand • Transcendence over the local environment 	<ul style="list-style-type: none"> • Solar System: structure and evolutions • Structure of the Milky Way • Local Groups of galaxies • Our place in the Universe 	<ul style="list-style-type: none"> • Relevant knowledge ("for the here and now") • Ethics of the human specie
• Dialectic	<ul style="list-style-type: none"> • Laws of the natural world • News observations and phenomenology 	<ul style="list-style-type: none"> • Exoplanets exploration • Galaxies and cosmology • Large scales structure 	<ul style="list-style-type: none"> • Teach the human condition • Coping with uncertainty
• Problems	<ul style="list-style-type: none"> • Adaptations to the changes reality • New conceptual reality 	<ul style="list-style-type: none"> • Relativity and gravitations • Climate change controversy • Exobiology and conservations • Future of the human race 	<ul style="list-style-type: none"> • Earthly identity

Figure 1. Heuristic comparison between the non-formal education of astronomy and the Bachelard and Morin theses.

from the truth; the school knowledge learned is in permanent doubt, and must be continuously validated. The obstacle of pragmatic knowledge, utility constitutes a principle of exclusion and an epistemological obstacle to knowledge. The obstacle of quantitative knowledge, also known as false rigor, blocks thought, it is a primary symbolic system that sometimes prevents the understanding of new knowledge. For other hands, Edgar Morín, proposes restructuring education in the twenty-first century; through what he called "the seven knowledge for the education of the future" [Morin \(1999\)](#): (1) Recognize the blind spots of knowledge: the error and the illusion, (2) The principles of the relevant knowledge, (3) Teaching the human condition, (4) Teach the identity planetary (5) To face the uncertainties, (6) The teaching of the understanding and (7) Ethics of the human race. The astronomy as a common scientific culture It postulates that education should be for life in the here and now. In addition, it is necessary to reorganize, not only the act of teaching, but also the fight against the defects of the system is important because it responds to Morin's principle of rational uncertainty, which invites us to ask ourselves about nature and the concept of humanity. It allows to inquire about the place of humanity in the universe and the finitude of life. This is where astronomy reveals itself to us as the science of interconnection between different disciplines and addresses fundamental problems. The regularities of the movement of the stars in the celestial spheres, showed that the natural world could be rationally understood. This cultural heritage on the role of astronomy to promote the study of nature; It is useful for non-formal collective education, and for the dissemination of science and technology among young people. The conceptual implications of Bachelard's epistemological and Morin's cognitive theses, in popularization of the astronomy can be summarized in Fig. 1. The conception about a dynamic rationalism, in the formation of scientific knowledge (Bachelard's foundation, column 1), remains manifested by the astronomy historical development; and by the systematic observation of the phenomena that take place in the apparent movement in the celestial sphere. (Column 2). These can be exemplified with relevant topics of current astronomy (column 3) that come to raise the thesis of the "Seven knowledge for the



Figure 2. The non-formal education in astronomy, as a tool for the scientific enculturation of the local population and non-formal teaching of Sciences and Technology.

Education of the Future” in the pedagogy of E. Morin (Column 4). It is clear that the list in column 2 is neither complete nor restrictive, but only indicated as relevant examples.

3. Implications

The activities of the SAUC focus on the didactic transposition of knowledge, avoiding the details of the rigor of metalanguage; in the use of the scientific spirit in the sense of Bachelard’s Philosophy. The astronomical observations of the present time, is concordant with the idea of education for the here and now, according to the Philosophy of Edgar Morin. The Astronomical Society of the University of Carabobo, develops outreach activities with a non-formal teaching approach of Science and Technology of a ludic nature Falcon (2009), such as seminars, amateur astronomy courses; traveling exhibitions, etc. In addition SAUC produces astronomy multimedia materials (videos, software, books, etc.). These activities and resources would generate the enculturation of the local population in science and technology. The qualitative evaluation of the process of scientific enculturation of the general population, can be evidenced by the heterogeneity and massive attendance of the public to the activities carried out (Fig. 2).

Part of the activities of the Astronomical Society is to collaborate with the youth sciences festivals, organized by the Venezuelan Association for the Advancement of Science, and also in the professional improvement activities of the Carabobo State Engineers Center. Also the SAUC produces, every years, the astronomical ephemeris of Venezuela for free, a work that was previously carried out by the Cajigal Naval Observatory until 2006. The qualitative evaluation, after two decades of activities of the Astronomical Society of the University of Carabobo, allows us to conclude that astronomy can affect

as a motivating axis for cultural appropriation and scientific enculturation by broad sectors of the local community: Regardless of age, gender, schooling, socio-economic activity or ideological-cultural diversity.

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