

Motivating the study of astronomy

Finita Poveda

Facultad de Ciencias, Universidad de Alicante,
Campus de San Vicente del Raspeig, 03690 San Vicente, Alicante, Spain
email: jmpg14@alu.ua.es

Abstract. One of the reasons for which this symposium has been organised is to seek answers to several questions, one of which being: *Can Astronomy help reducing the waning interest that the younger generations of students feel about science studies?* My personal opinion is that it is indeed the case. In fact, I claim that astronomy can be very effective for this aim. The present situation of pupil shortages in scientific studies is a complex problem because there are multiple and diverse variables influencing this situation. One of them is that the contents are not introduced in the most appropriate form, because the methods used in teaching scientific disciplines are not appropriate. This paper relates my personal experience; first as a teacher and then as a student at the Faculty of Sciences in the University of Alicante.

Keywords. Teaching Astronomy, Astronomy in schools, Methodological bases

1. Introduction

There are four key concepts, according to psycho-pedagogical theories:

1.1. Perception

The human brain first perceives a totality and afterwards analyzes the fragments of that totality. Let us say that in the first place we perceive a scene and later on we analyze the parts of this scene, noticing for instance that there are some cars circulating and others that are stopped.

If the teacher begins by providing a totality, from this starting point the students can carry out several actions: they can either split it into fragments, or establish fragment-context and fragment-fragment relationships; or even analyze these relationships that they have established in other previous contexts or with other previous fragments, in what is known as **effective learning**.

What happens if we choose the opposite way; that is to say, if the teacher begins by providing the fragments? Probably, a lot of students will not be able to establish relationships with the context, since they do not have it, because they have not been given it previously. When teachers, instead of beginning a lesson with the totality, begin by providing the fragments, it is as if they asked their students to solve a puzzle with no previous information about the picture they should compose. Sooner or later, the students will complete the puzzle (supposing that they are not discouraged before finishing it) but, *will they finish it quicker if they know what image they are supposed to compose?*

1.2. Thought

Thinking is an activity from which two consecutive actions are carried out: 1st) **Abstracting** -to extract from a totality its essence- and 2nd) **Generalizing** -to extend to a totality those features which characterize a fragment-

I wonder... *how to extract from a totality its essence, if I do not possess the totality?* If I do not have the totality, I cannot abstract, I cannot generalize and, in consequence, I cannot think.

1.3. *Effective learning*

To achieve effective learning we must begin with a totality, i.e. *Global, Significant, Interdisciplinary* and, mainly, *Motivational* (that encourages the action).

1.4. *Method*

“*Sequence of actions by means of which the transmission of the contents is fulfilled*” (the path to follow from your departure to your arrival). There are quite a lot of methods, as many as approaches can be chosen when establishing the sequence of the contents. In general we can claim that the best method is that which helps to obtain the best results (= perfect ones) in the shortest possible time.

With regard to the global approach, we can opt between two method types: **Top-Down** and **Bottom-Up**. Most of the books that I have consulted about Astronomy, published before the decade of the 60s, are books that follow the global **Top-Down** method; and it is from this date on when the use of the **Bottom-Up** method begins to be imposed.

1.4.1. *Bottom-up method*

This begins with the FRAGMENTS to arrive at the totality. Teachers progressively offer pieces of the puzzle and students keep composing it. For example, in Astronomy, it would be something like this:

- Lesson 1. Historical evolution
- Lesson 2. Celestial Mechanics
- Lesson 3. Solar System
- Lesson 4. Instrumentation
- Lesson 5. The Stars
- Lesson 6. The Milky Way
- Lesson 7. Nebulae
- Lesson 8. Origin and End of the Universe

1.4.2. *Top-down method*

Here, one begins with the totality to arrive at the FRAGMENTS. We begin with a global context and focus the contents in a downward scale until we arrive at a specific subject, at the individuality (lesson 6). With an historical revision (lesson 7) we provide the perception of past time and we finish by contributing tomorrow’s perspective (lesson 8), with which we can sow a certain seed of curiosity. For example:

- Lesson 1. A Window to the Infinite
- Lesson 2. The Route of the Galaxies
- Lesson 3. Domains of the Milky Way
- Lesson 4. Stellar Genesis
- Lesson 5. Surroundings of the Earth
- Lesson 6. The Earth in the Sky
- Lesson 7. Historical stages
- Lesson 8. The Astronomy of the Future

2. Overview

Thinking of the incongruities between what the theory says and what is done in practice, I made a survey among astronomers. The question was: *What do you remember of your first experience with Astronomy?* Their memories were experiences that went back

to their childhood, in emotional environments related to family or friends, or amusing situations, always endowed with a great amount of affective value.

Everyone gave me answers of this type:

- Hunting for shooting **stars** and request a desire
- Recognizing **constellations**
- Finding the Milky Way
- Learning the names of the **stars**
- Astonishment because the **stars** can move
- Fascination due to the fact that there are double **stars**

And nobody responded the following:

- Hunting for shooting eclipses
- Recognizing cardinal points
- Finding the ecliptic
- Learning about celestial motions of rotation, precession, nutation, etc.
- Astonishment because the planets have retrograde movements
- Fascination due to the fact that it is the Earth which rotates around the Sun and not the other way round

However ... *How do the scholars enter the world of Astronomy?* Generally speaking and starting from what is being carried out, we can deduce three conclusions:

(a) After 10 years studying Astronomy, youngsters have received little or no information about the stars, which was what led the professional astronomers to choose their scientific careers.

(b) Students do not begin with a global context, with a totality from which they can extract their essential features. Because of this, we are not teaching them to think.

(c) At school a non-global strategy, the **Bottom-Up** method, is still being used.

I wonder ...

Why have many teachers lost their enthusiasm and creativity?

Maybe, because they lack a dynamic and effective method able to produce genuine results?

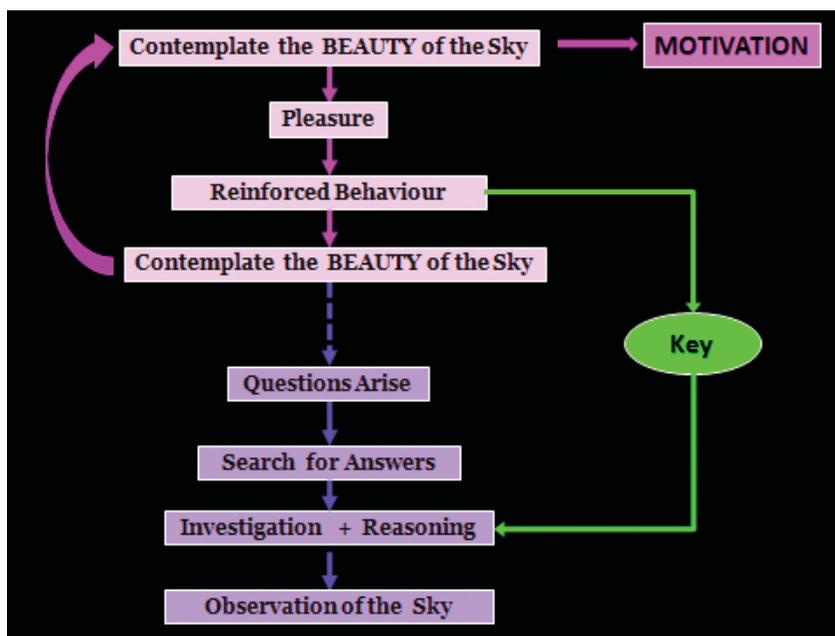
If this is the case... Could that not be the reason why they offer boring explanations, demand irrelevant tasks and carry out absurd assessments?

I am astonished when I hear sentences like this: *"It is not necessary to try to disguise the contents in order to prevent them from being boring for students"*. Indeed, there are no boring contents, especially if we are speaking about Astronomy. Learning can be a pleasant and amusing activity. What can be crushingly boring, because it is not appropriate, is the method. If we structure the contents without keeping in mind the way the brain works: how it perceives, how it thinks and how it learns; astronomy lessons will become a terrible torment. And Victor Hugo already said: *"Nature speaks while mankind does not listen"*.

When we speak, for example of the Sun, *why we do omit the idea that although in the morning it is force and strength -a glowing flame- and in the afternoon it is melancholy and fragility -a dying flame- but it always exhibits the same beauty?*

Beauty is an intrinsic part of nature (and of us, too). Nature possesses the capacity to delight, which is achieved by means of perceptions.

Watching the beauty of a starry sky produces pleasure. We know that all pleasant behaviour is automatically reinforced, because human nature, that naturally tends to which pleasure, repeats the behaviors that are found to be pleasant; therefore, we will repeat the view of the sky. Thus enter a virtuous circle which we leave when the mere view is not enough, because sooner or later questions arise. And after questions there follows the search for answers. *How?* Well, by means of investigation and reasoning; to be precise, by means of thinking (to **abstract** and to **generalize**, as in *can you remember?*). At that moment, the sky is no longer contemplated. It is observed! We can say then that an astronomer has been born. But to end up observing, we have had to begin watching the sky as a whole, we have had to begin with a global totality, a *significant, interdisciplinary* and, mainly, *motivational* one. Because the key to the question is, in reinforcing the motivational behavior (view of the sky), to arrive at investigation and reasoning.



When ten years ago I came into the world of Astronomy, I only wished to learn the names of stars and recognize the celestial landscape just as I recognized the landscape of my town. Watching the sky satisfied me and nothing else was important for me. But the moment did arrive when questions arose: *Why does a star shine? How does it emit light?* For three years I looked for answers at the University of Alicante. Fortunately, I was able to choose the method and opt for the topics that were more interesting for me, accidentally coincident with those that left a permanent mind-mark in those astronomers interviewed by me. I have experienced the discouragement that an inadequate method produces. It is like *drifting aimlessly*, a feeling that causes rejection. And also the pedagogical theory tells us that, “*any person, when faced with a situation he or she rejects, will inevitably avoid that situation if it is at all possible*”.

3. Conclusions

The contradiction between the natural form in which content is perceived and assimilated by the brain and the unnatural form by means of which the contents are elaborated,

is in my view, one of the main reasons that explains the fact that there are so few students that choose the scientific option in their education, that those who choose it are discouraged and finally give up, and that many of those that finish their studies possess scant training and little motivation. And it is very difficult, practically impossible, to learn without motivation.

I propose, from my modest experience, that the contents should be *clear, brief and concise*, and that they should be presented *starting from a global structure*. This way students will be allowed to establish links between pieces of information, if we begin with a totality and afterwards split it into fragments, favoring **critical thought**, and taking advantage of their effort. This is what we can call amusing and stimulating activities!!!

Teaching is a Science but it is also an Art. And teachers, just like artists, need an effective method to guide them along a specific path when they are working on their master-piece. Just as the painter begins by sketching the main features and leaves the particular details to the end, the study of Astronomy is demanding this very strategy. *Possessing knowledge* is not the same as *knowing how to teach* and the success of the teaching-learning process, to a great extent, arises from the kind of the method put into practice.

Acknowledgements

I am extremely grateful, for the assistance they provided, the enthusiasm transmitted, and the invaluable moral support they gave during the preparation of this paper, to the following: Amparo Ombuena (UGT, Alicante), Rafael Aleman (Universidad Miguel Hernández), Fernando Ruiz (Universidad de Alicante), Bryn Moody (formerly of the Faculty of Education, Universidad de Alicante), and my fantastic family.

References

- Aristotle 1966, *Del sentido y lo sensible; de la memoria y el recuerdo* (Madrid: Aguilar)
Barrio, J. 1998, *Taller de Astronomía (E.S.O.)* (Madrid: Laberinto)
Comas Solá, J. 1939, *Astronomía* (Barcelona: Sopena)
Montessori, M. 1910, *Antropología pedagógica* (Barcelona: Araluce)
Piaget, J. 1968, *Educación e Instrucción* (Buenos Aires: Proteo)
Pozo, J.I., & Gómez Crespo, M.A. 2006, *Aprender y enseñar ciencia* (Madrid: Morata)