

# Science of evolution: between the historical science and functionalist science.

## Which approach adopted in the secondary education in Morocco for improving the environment of science study?

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**Abstract.** Science of evolution is the basic of life and earth science (LES). It searches for mobilize the process and reasoning of tow scientific poles: functionalist and historical. Because it try together to reconstruct the history of living beings from their origins and to explain the working biological mechanisms in this process. Therefore, studies of evolution must respect this double polarization.

In this article, we analyzed the programs of studied subjects in life and earth sciences for secondary school in Morocco to know how this polarization is taken into accent.

We show that the programs of life and earth sciences are heaving biased toward the scientific pole functionalist. So, the historical sciences remains poor and implicit.

This tendency, patent in the programs of life and earth science, might reveal probably more the difficult of evolution studies in Morocco.

## 1 introduction

The object of the analysis presented in this article is studying the theories of evolution in the didactic, epistemological, and historical aspects in order to identify the obstacles and difficulties related to these theories in the context of theorizing.

The evolution is a scientific object considered as the base of the sciences of the life and the earth "Nothing makes sense in biology unless it is in the light of evolution". It is a very complex scientific object, because it links between two poles of sciences: historical sciences and functionalist sciences [1].

Many recent researches in science didactics focus on the nature of science and its consideration in teaching. Science subjects should provide students with scientific knowledge as well as epistemological knowledge. That is to say, the student in his learning of scientific concepts and theories must question and understand what is scientific knowledge, its mode of construction and its evolution in history. Moreover, this cannot be allowed unless the student is placed in the historical context of this scientific knowledge [2].

The main question of this article: What place should be given to historical sciences in the LES programs in the 2nd year of the baccalaureate, especially in the chapters devoted to the theme of evolution?

An epistemological and didactic analysis of the Moroccan LES programs at the secondary level allowed us to identify the methodological choices, based on the criteria of demarcation between historical science and functionalist science that will be used in our analysis grids of the programs.

Our article is structured in two parts: the first part focuses on the criteria of demarcation between historical sciences and functionalist sciences. The second part shows how these two elements are explicit in the LES programs.

## 2 Theoretical framework:

### 2.1. Defining Historical and Functionalist Sciences:

Life and Earth Sciences (LES) are considered in the school world as "experimental sciences". The experimental sciences, from an epistemological perspective, include both those sciences whose methodology allows for "experimentation" and those that use data from "sensible experience." [3].

Thus the definition of experimental sciences is composed of two scientific poles: functionalist sciences (sciences whose methodology authorizes experimentation), and historical sciences (which use data from reality). However, in the school world, the

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expression "experimental sciences" mostly designates experimental approaches in the strict sense, ignoring the historical sciences.

Since the theme of evolution in the secondary school LES program is taught in the life science or biological science section. As Jean Gayon explains, biology, since its emergence in 1802, has had "a double objective: on the one hand, to discover the universal laws that make life possible as a general fact, and on the other hand, to draw up a picture of its diversity and history of its diversity and its history [4].

Thus, the teaching of evolution must emphasize both the processes at work in evolution and the history of the living world, thus respecting the duality of the experimental sciences (historical sciences and functionalist sciences).

### 2.2 The fields of study of evolution as a historical science and a functionalist science:

The field of study of evolution in a historical perspective is to study the structures of living beings and the causal relations of their temporal sequence. While in a functionalist perspective, the field of study of evolution is to study the functioning of living beings, both at the individual scale and that of the population, the species or the ecosystem. [3]

The following table (1) illustrates a list of general terms that can encompass items that correspond to evolutionary themes. This list is based on the work of several authors who have worked on this issue [3, 4, 6].

**Table1.** List of general terms belonging to the field of study of evolution.

	Field of study as Functional Sciences	Field of study as Historical Sciences
General terms belonging to the field of study of evolution	Variation Mutation Heredity Reproduction Selection Genetic drift Speciation Adaptation	living being Character Diversity Phenotype Genotype Fossil Species, Population Kinship, filiation

According to this demarcation between the specialist terms of the field of study of evolution from a historical science perspective and a functionalist science perspective, it can be said that the knowledge objectives for the two perspectives are clearly different. But evolution as a teaching subject should respect the objectives of these two scientific poles.

## 3 Materials and methods

### 3.2 Purpose and framework of analysis:

Let us recall that the objective of this article is to identify in the secondary school LES program, the respective place of the historical sciences and the functionalist sciences. For this reason, we will base ourselves on the criteria of demarcation between the objectives of knowledge of the historical sciences and the functionalist sciences. This distinction is operative for our study, because we can recognize in the curriculum what belongs to the historical sciences and what belongs to the functionalist sciences.

### 3.2 Study corpus:

The corpus of study consists of the Manual of LES of second baccalaureate (Al jadid in LES, dar Nachr al maarifa, 2011 edition, series life and earth science). And the pedagogical guidelines of LES in qualifying secondary cycle (July 2007) [7, 8].

### 3.3 Analysis Methodology

The first work carried out on this corpus consists in raising the whole of the contents in reference to the evolution intended for the teaching in second year Baccalaureate starting from the pedagogical orientations figure (1). Whereas the second work is carried out on the analysis of the manual by raising the whole of the terms and concepts in reference to the same field of study[7]. The set of terms retained are the units of analysis that are analyzed with regard to the criteria of differentiation of the historical and functionalist poles to determine the explicit reference to one pole or the other.

#### 3.3.1 Content in reference to the evolution of the second baccalaureate program:

الخصص	التغير و علم وراثته الساكنة	الوحدة الرابعة
	* الأولى الإعدائية: العلاقات بين الكائنات الحية وتفاعلها مع الوسط * الجذع المشترك العلمي: علم البيئة - التوالد عند النباتات. * الوحدة الثانية: طبيعة الخبر الوراثي وآلية تعبيره. * الوحدة الثالثة: نقل الخبر الوراثي عبر التوالد الجنسي - علم الوراثة البشرية.	1. المكتسبات القبلية 3
12 س	* الدراسة الكمية للتغير (القياس الإحصائي)..... - تغير متواصل و تغير غير متواصل - مفهوم السلالة النقية * علم وراثته الساكنة (Génétique des populations)..... - توازن الساكنة + مفهوم الساكنة، تعريفها + المحتوى الجيني للساكنة (Le pool de gènes) + قانون Hardy و Weinberg - عوامل تغير الساكنة + الطفرات + الانتقاء الطبيعي + الانحراف الجيني <sup>(1)</sup> (La dérive génique) + الهجرة (Migration) - التطور الضمني + المعايير المميزة للنوع + تعريف النوع + دراسة مثال لتطور نوع معين	2. المضامين المراد دراستها والغلاف الزمني المخصص لكل منها 17 س
30 د	في بداية معالجة الوحدة.....	4. التقييم والدعم
60 د	في منتصف الوحدة.....	* التقييم القبلي
90 د	عند نهاية الوحدة.....	* التقييم التكويني + الدعم
120 د	عند نهاية معالجة الوحدة وينبغي أن يشمل مكونات الوحدة.....	* التقييم الإجمالي
34 س		المجموع

\* دون التفرق إلى آليات الانحراف الجيني.

Fig. 1. Excerpt from the pedagogical guidelines of the LES program in qualifying secondary schools with reference to the theme of evolution.

## 4 Results and discussion

### 4.1 The pedagogical orientations Analysis

#### Result:

	Field of study as Functionalist Sciences	Field of study as Historical Sciences
General terms belonging to the field of study of evolution	Continuous variation Discontinuous variation Biometry Mutation Natural selection Gene drift Migration Hardy-Weiberg's law The gene pool	Species Population Interspecific evolution

Number of terms found	9	3
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### 4.2 life and earth science (LES) Manual Analysis

#### Result:

	Field of study as Functionalist Sciences	Field of study as Historical Sciences
General terms belonging to the field of study of evolution	Continuous variation Discontinuous variation Biometry Mutation Natural selection Genetic drift Migration Hardy-Weiberg law The gene pool Frequency curve Artificial selection Quantitative study Statistics Conservative selection Mass selection Randomness Conformity test Selective advantage Random Adaptation Isolation Process Reorganization Codominance Substitution Genetic mixing Variance Amplitude	Species Population Interspecific evolution Genotype Hereditary heritage Genotypic composition Polymorphism Ancestry Generation Speciation Similarity criterion Reconstitution Fossil Genus Sonship Progressive Genealogical tree

	Coefficient of variation Positional parameter Dispersion parameter	
Number of terms found	31	17

The terms collected are examined in relation to our analysis indicators (criterion of differentiation of functionalist and historical sciences), which makes it possible to identify either in the pedagogical orientations or in the LES manual to what extent these programs convene the functionalist and historical poles. According to the results obtained, we notice an imbalance between the place given to the historical sciences and the functionalist sciences. The general observation of our analysis is that the existence of the practices of the historical sciences are in the minority in these programs on the contrary of those of the functionalist sciences which are the object of more numerous and precise practices.

Life and earth sciences (LES) are among the school disciplines that belong to the experimental sciences. The latter, as already mentioned, encompasses the functional sciences and the historical sciences. However, what is clear from the analysis of the LES programs in the context of evolution is that the expression "experimental sciences" is often synonymous with functional sciences and does not include the particularities of historical sciences. With the exception of a part devoted to the study of the evolution of equids, that evolution can be seen in a historical perspective, but the problem is that this part is among the parts not included in the taught program (part removed from the taught program).

For our part, we consider that evolution is a fact that has consensus within the biological community. However, the fact that we also consider that there is divergence when it comes to explaining the mechanisms of this evolution in both functionalist and historical dimensions would constitute, from a didactic point of view, a wealth to be exploited. However, the new content of Moroccan textbooks (biological process of evolution within the population in terms of variation), by not making explicit

reference to any historical study, hinders this exploitation and would limit the pedagogical intervention.[9]

Adopting a historical approach to science allows students to build an idea of how scientific knowledge is structured, how theories are developed, the eminently socio-constructivist nature of scientific practice, etc... Goals, highly solicited in the training or education to science and its practices.

### 5. Conclusion

In this article, we try to clarify the epistemological status of historical sciences and functionalist sciences and their respective places in the teaching of evolution at the secondary level in Morocco.

In this analysis, it appears that there is a low level of explicitness for the historical pole compared to the functionalist pole.

This result leads us to argue here for a teaching of life and earth sciences that does not take into account their epistemological dimensions.

Knowing that the ambition of the teaching of the scientific subjects is not summarized in the acquisition of the knowledge called scientific, but rather in the insertion of the pupil in the historical context of the construction of this knowledge.

Thus, making the historical sciences visible in the teaching of science in general and evolution in particular seems to us to be a relevant entry point for covering the epistemological dimensions of evolutionary teaching.

Having students, work in the historical scientific field will naturally stimulate their reflection on the nature and mode of construction of science.

What we want to highlight in this article is the interest of teaching evolution from a historical perspective, which forces us to fully reflect on the nature of the knowledge at stake and its modes of construction. Knowing this epistemology allows one to master scientific concepts, something that is not achieved in the teaching of evolution in the Moroccan context.

Finally, this study has shown that the historical dimension may be necessary for teachers to address the topic of evolution in a pedagogical manner in their classrooms.

It was also suggested that the historical dimension could serve as a source of examples, analogies, metaphors, and stories related to the various aspects of nature of science NOS that enhance the science study environment in general. .[10]

The potential effectiveness of collaborative efforts between science teachers and historians of science in developing and improving the science-studying environment could be a fruitful avenue for future research...

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