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THE PLACE AND PEDAGOGICAL FUNCTION OF THE SCIENTIFIC IMAGE IN MOROCCA LIFE AND EARTH SCIENCES TEXTBOOKS

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ABSTRACT: *The discovery of details, knowledge of the structures and composition of biological and geological elements is a very important step in the understanding of the scientific phenomena programmed in the SVTs lessons. Thus, scientific evolution has made it possible to explore different levels of organisation at ever deeper levels, whether in biology or geology, through the innovation of instruments and tools for exploration and observation, ranging from a simple magnifying glass to sophisticated techniques such as tomography or medical imaging. Textbooks transpose the results of these observations into scientific images that help learners to understand the phenomena under study as well as to develop a critical mind towards the proposed contents and to problematize their own knowledge within the framework of a competency-based approach that is adopted by the Moroccan education system. With the aim of evaluating the place and functions of scientific images of order: microscopic, magnifying observations and medical imaging, we analysed a corpus of 12 textbooks from the Moroccan educational system. We selected one copy of different accredited textbooks from each level of education. These are the textbooks for scientific awakening for the six years of primary education, three textbooks for middle school and three for high school. The analysis is carried out with the help of a self-developed grid which takes into account the percentages of each type of scientific images studied and their functions. The results showed that there is an evolution in the appearance of the scientific images studied as one progresses towards the second year of the baccalaureate: almost the majority of primary school textbooks do not include microscopic or magnifying observations or medical images, but they appear in the other levels with percentages that differ from one textbook to another. Microscopic observations are the most abundant among the other types of scientific images studied. Thus, scientific images with an illustrative function predominate, while those with a heuristic function and recommended in the competency-based approach are present in only a small percentage.*

KEYWORDS: assessment, scientific image, textbooks.

INTRODUCTION

Morocco's post-independence education system has undergone several curricular reforms aimed at improving the quality of learning and developing approaches that help learners master the various knowledge and skills required at each school level, while adopting a pedagogy that promotes the development of skills related to know-how and life skills such as observation, expression, criticism, research and synthesis (CSEFRS, 2015).

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Lessons relating to life and earth sciences are present in the curricula from the primary cycle, in the discipline of scientific awakening, then in the middle school and high school in the discipline of life and earth sciences, while trying to enable the learner to have a global view of the main biological and geological concepts throughout his or her school curriculum (O.P, 2007).The discovery of details, knowledge of the structures and composition of biological and geological elements is a very important step in the understanding of the scientific phenomena programmed in the SVTs lessons. These observations are transposed to the textbook level as scientific images to be used as an investigative tool, playing different pedagogical functions, thus helping the learner to construct the desired scientific design. Textbooks are considered as a stage of didactic transposition because textbook publishers operate on the one hand a selection of knowledge objects, and on the other hand a textualisation (Grosbois, 1991).

Thus, the Moroccan education system adopts the competency-based approach, which is based, among other things, on the problematisation of phenomena in order to create a cognitive conflict in the learner that will lead him or her to seek and find answers to the problems posed even if his or her knowledge is limited (Sabir, 2015). If the phenomenon studied is related to biology or geology, several approaches are possible to adopt during the solution-finding and knowledge mobilisation stage, such as the experimental or investigative approach. The experimental approach consists of carrying out practical work and experiments, which is not really used in Moroccan schools because of several constraints, especially those relating to the lack or inadequacy of teaching materials at both primary and secondary levels (ONDH, 2017), whereas for the investigative approach it is carried out in almost all cases with reference to school textbooks, which are composed of numerous activities each involving a variety of scientific documents to be used by learners (Hassouni et al., 2014). Microscopic observations, magnifying glasses or medical imaging are among the documents that textbooks can incorporate by reserving a place for them in the textbooks and giving them a specific pedagogical function. In order to study the place and functions of these scientific images, we tried to answer these two research questions:

What place is given to microscopic observations, magnifying glass observations and medical imagery in the textbooks of the Moroccan SVTs? And what are their pedagogical functions?

METHODOLOGY

The Corpus of Analysis

The analysis is carried out on a corpus of 12 textbooks from the Moroccan education system, each of which belongs to a school level and represents a copy of the different textbooks accredited for these levels of education. These textbooks are those for the six years of primary education, three middle school textbooks and three high school textbooks.

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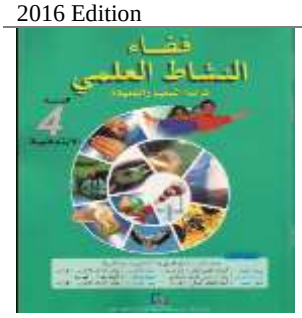
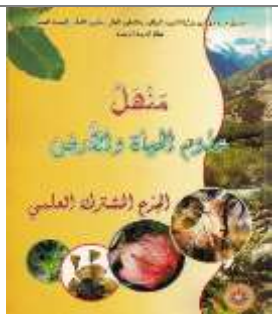
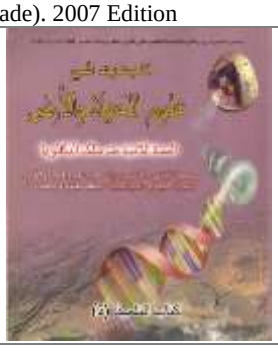
Table 1.The corpus of textbooks analysed.

Primary	Al Asasi in scientific awakening of the 1st year of primary school (1st grade) 2018 Edition	Al Mokhtar in scientific awakening of the 2nd year of primary school (2nd grade) 2018 Edition	Al Wadih in scientific awakening of the 3rd year of primary school (3rd grade) 2017 Edition
			
	Al Fadae in scientific awakening of the 4th year of primary school (4th grade) 2016 Edition	Al Manhal in scientific awakening of the 5th year of primary school (5th grade) 2017 Edition	Al Tajdid in scientific awakening of the 6th year of primary school (6th grade) 2017 Edition
			
Middle school	Al Mofid in Life and Earth Sciences of the 1st year of Middle school (7th grade). 2015 Edition	Al Masar in Life and Earth Sciences of the 2nd year of Middle school (8th grade). 2019 Edition.	Fi Rihab in Life and Earth Sciences of the 3rd year of Middle school (9th grade). 2018 Edition.
			
High school	Al Manhal in Life and Earth Sciences of the Common Scientific Core (10th grade). 2012 edition	Fi Rihab in Life and Earth Sciences of the 1st year of the Baccalaureate of Experimental Sciences (11th grade). 2006 edition	Fi Rihab in Life and Earth Sciences of the 2nd year of the Baccalaureate of Experimental Sciences and Mathematical Sciences (12th grade). 2007 Edition
			

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Concerning the primary MS, since they incorporate (in addition to the Life and Earth lessons) lessons related to physical sciences, we focused our analysis just on the parts that deal with SVT lessons.

Investigation Tool

We used an analysis grid developed by ourselves and validated by experts, which is based on two criteria:

The method by which the scientific images studied were made: by microscope observation, by observation with a magnifying glass or by medical imaging techniques. These images are all figurative images with a particularity for medical imaging images which can also be considered as mixed scientific images (assembly of graphic and figurative images) (Clément, 2011). The pedagogical function of these images within textbooks: aesthetic, illustrative, heuristic or evaluation:

Table 2. Pedagogical function of the scientific images

Aesthetic	Illustrative	Heuristic	Assessment
Images that have aesthetic functions only. Little or no scientific information is provided by these images, but they embellish the textbook with amusing diagrams, or images related to the subject of study but unrelated to the text. This type of image is used to motivate learners	Images expressing a scientific message, presenting evidence, etc.	Images that have aesthetic functions only. Little or no scientific information is provided by these images, but they embellish the textbook with amusing diagrams, or images related to the subject of study but unrelated to the text. This type of image is used to motivate learners	Images expressing a scientific message, presenting evidence, etc.

Data Analysis

The processing of the results of the textbook analysis is done by Microsoft Office Excel 2007.

RESULTS

All textbooks

Out of all textbooks, we found that scientific images of microscopic observation types occupy the first place, followed by images of medical imaging and then images of magnifying glass observations.

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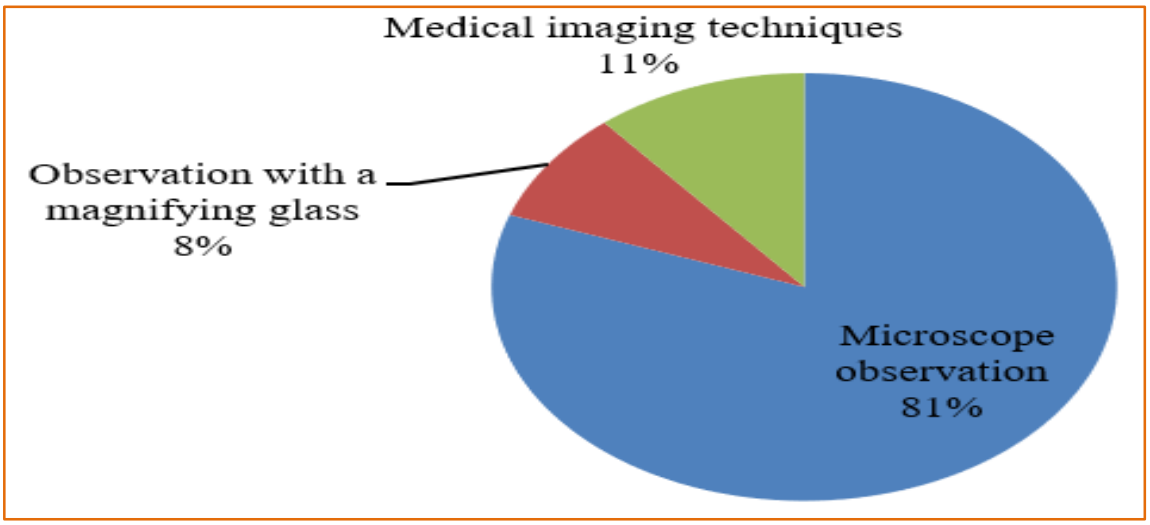

Figure 1.Distribution of the scientific images studied according to their types in all textbooks.

Looking at these three types of scientific images from the point of view of function, we found that images with an illustrative function are very abundant throughout the corpus, with a percentage of 71.68%. Images with an aesthetic function come second with a percentage of 17.41%, while evaluation and heuristic images occupy the third place with very similar percentages (5.75% and 5.12 respectively).

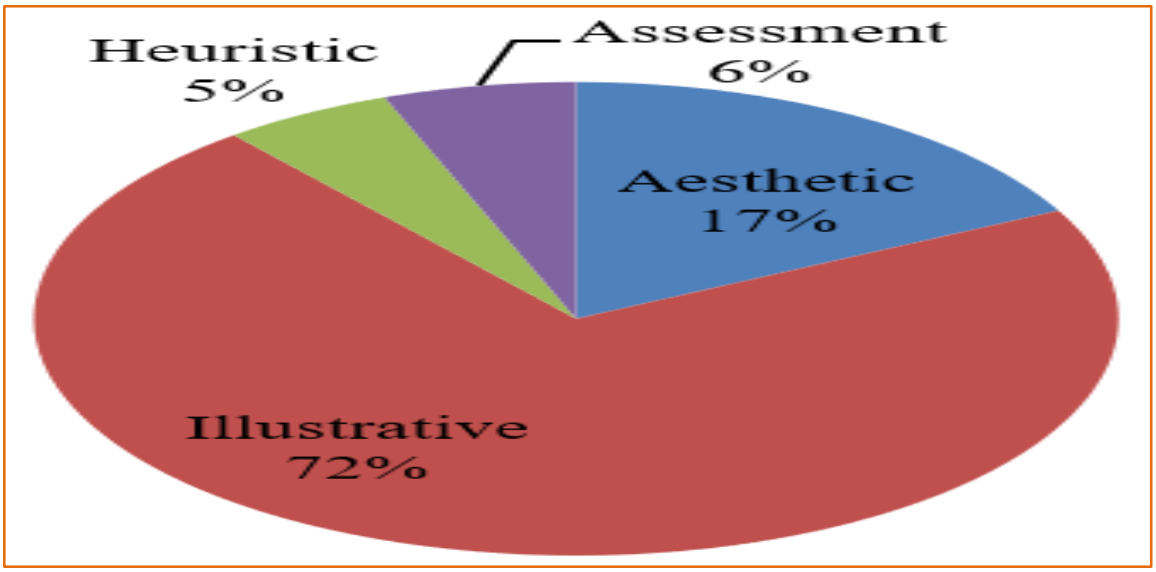

Figure 2. Distribution of the scientific images studied according to their pedagogical function in all textbooks.

Microscopic observations were used to perform all four functions, with a remarkable dominance of their use as illustrative scientific images, followed by the aesthetic function, while the heuristic and assessment functions account for only 4% (each) of the total number of images. It is equally the same order for the medical images, but with smaller percentages. The same trend is respected by the magnifying glass observations,

except the fact that they are not found as aesthetic images. Heuristic magnifying glass observations account for only 0.48%.

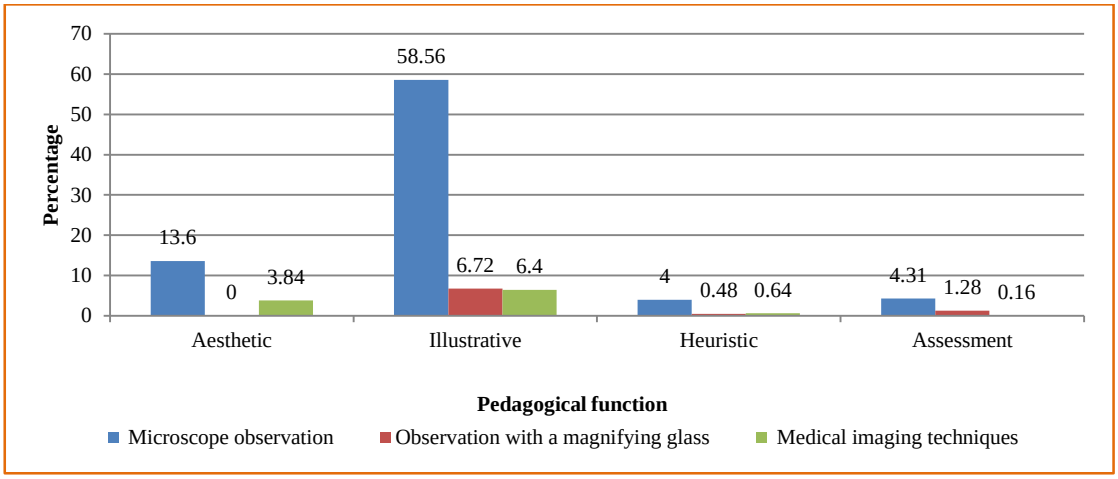

Figure 3. Distribution of the scientific images studied according to their pedagogical function and types in all textbooks.

Results according to Level

In breaking down textbook by textbook, we found that these overall results hide a massive absence of scientific images from microscopic observations, magnifying observations and medical imaging in five textbooks in the corpus. Thus, we found a condensation of these images in the middle school and high school textbooks.The textbooks in which these images are absent are those of four primary school levels: 1P, 2P, 3P and 5P. Even the textbooks that are outside this list (4P and 6P) incorporate only one type of scientific images studied that is observation with a magnifying glass, having illustrative and evaluation functions.

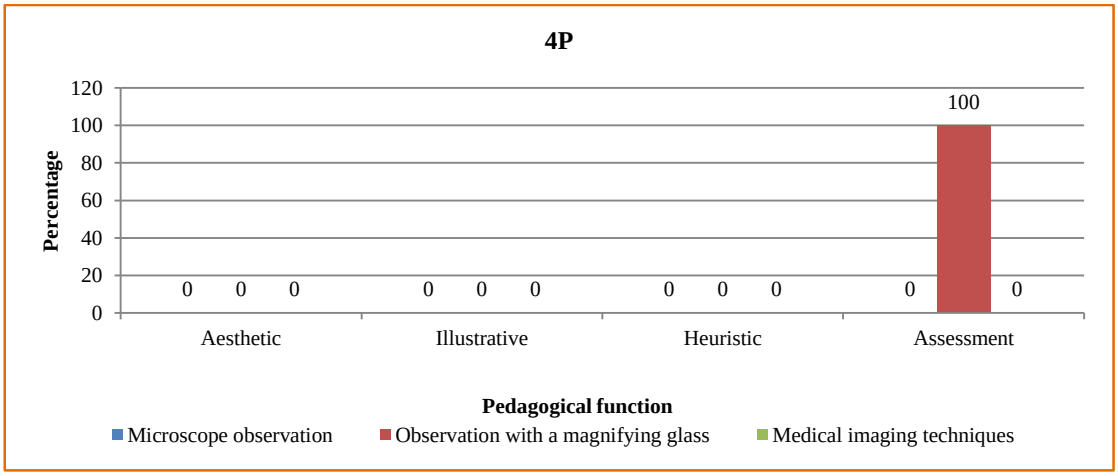

Figure 4. Distribution of the scientific images studied according to their pedagogical function and types in 4th year of primary textbooks.

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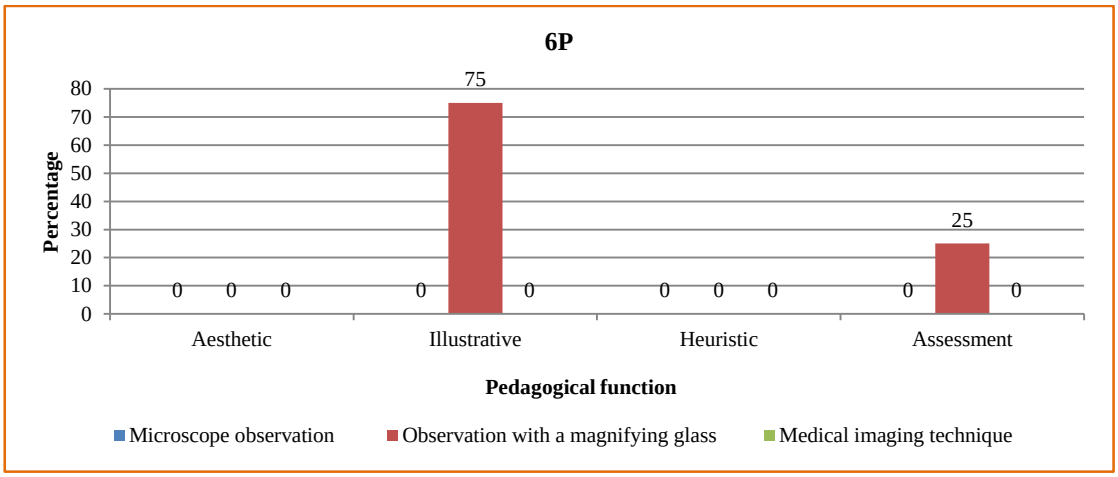

Figure 5.Distribution of the scientific images studied according to their pedagogical function and types in 6th year of primary textbooks.

With regard to middle school textbooks, the 9th grade textbook contains a remarkable number of the three types of scientific images studied in this order of importance: microscopic observations, medical images and magnifying glass observations. The same order is found in the 8th grade textbook with lower percentages, while in the 7th grade textbook we note an absence of medical images.
The distribution of scientific images according to their function in middle school textbooks shows a similarity with the overall results.

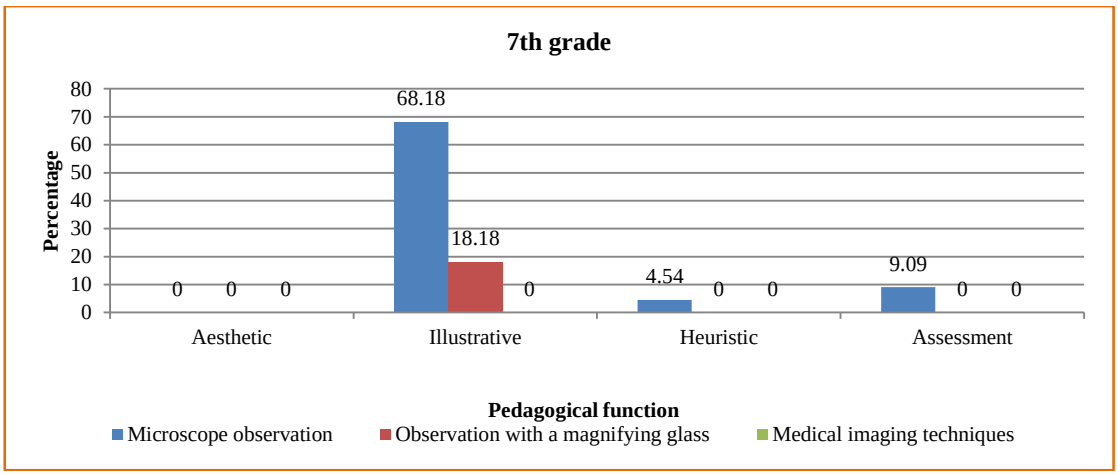

Figure 6. Distribution of the scientific images studied according to their pedagogical function and types in 7th grade textbooks.

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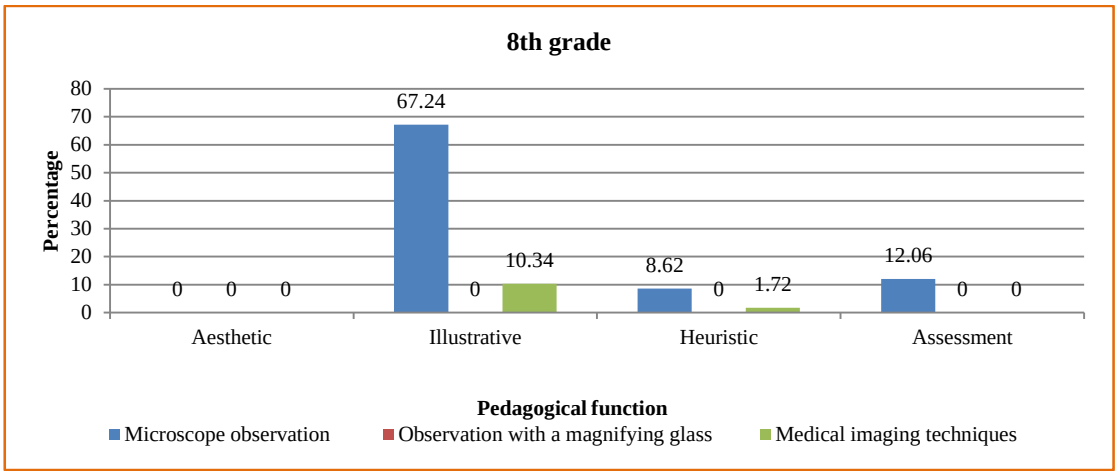

Figure 7. Distribution of the scientific images studied according to their pedagogical function and types in 8th grade textbooks.

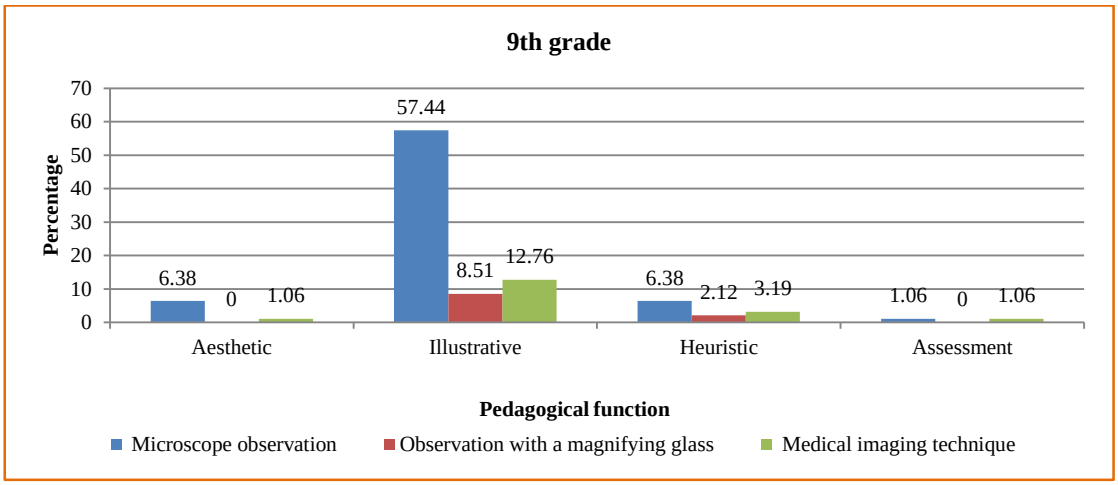

Figure 8. Distribution of the scientific images studied according to their pedagogical function and types in 9th grade textbooks.

In the three textbooks of the qualifying cycle (high school), we note a significant abundance of microscopic observations. In the 12th grade textbook there is a weak presence of medical images, whereas they are absent in the 10th grade textbook. The percentage of observations under the magnifying glass is low in the textbook of 12th grade compared to those of the 10th grade and 11th grade.These images mainly have an illustrative function; only a few microscopic observations have a heuristic and evaluation function. In the textbook of 11th grade, a large percentage of the aesthetic images are revealed.

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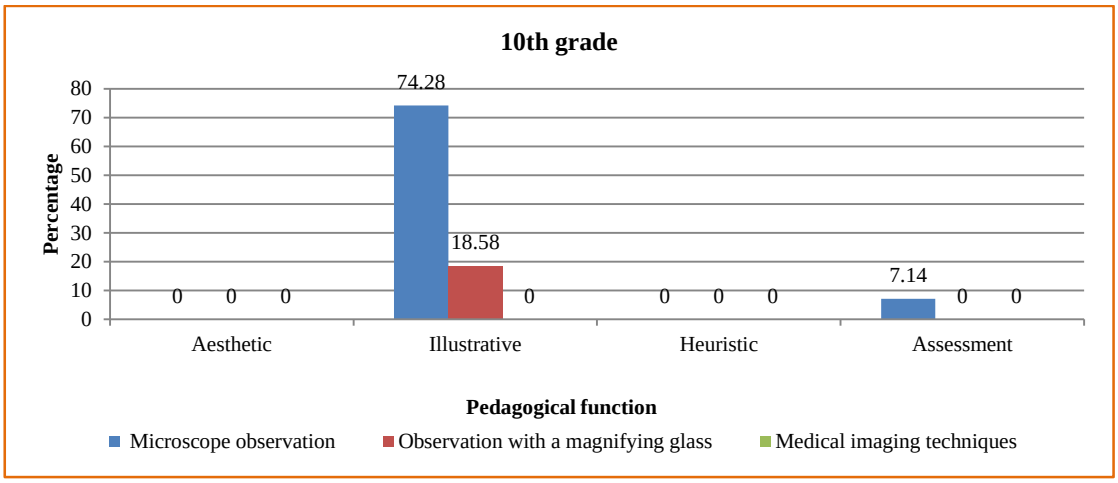

Figure 9. Distribution of the scientific images studied according to their pedagogical function and types in 10th grade textbooks.

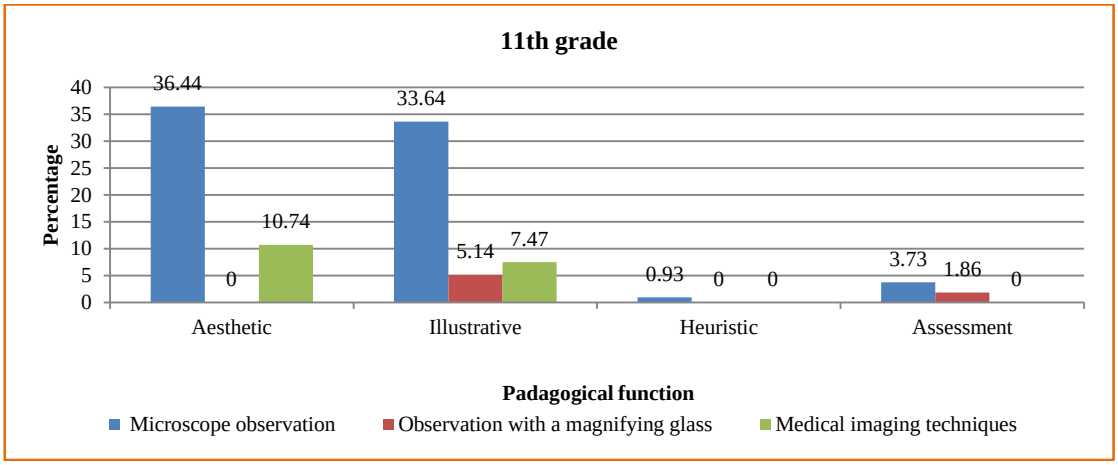

Figure 10. Distribution of the scientific images studied according to their pedagogical function and types in 11th grade textbooks.

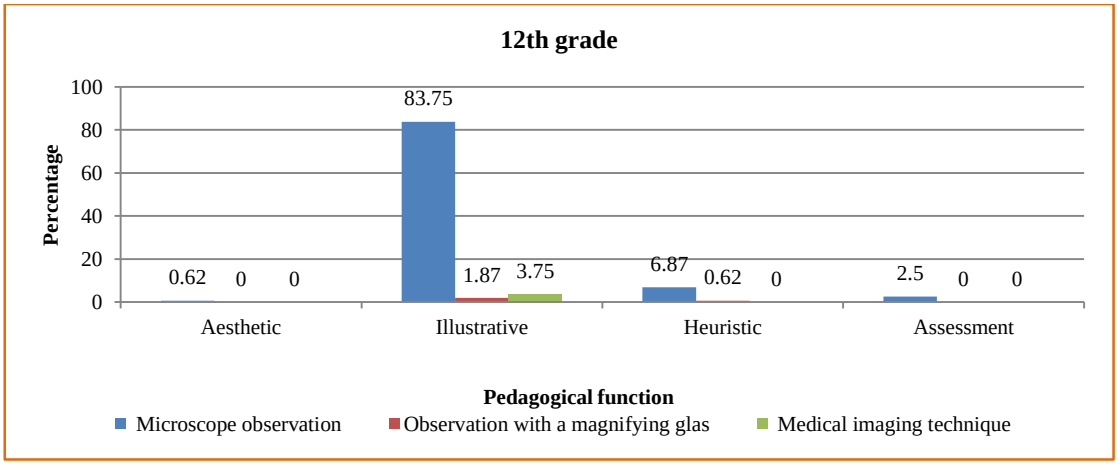

Figure 11. Distribution of the scientific images studied according to their pedagogical function and types in 12th grade textbooks.

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DISCUSSION

The absence of microscopic observations in primary school textbooks is a remarkable result. This absence can be traced back to the curricula: the cell and geological phenomena as concepts do not appear in the primary school curriculum, but appear in those of middle school and high school under the name of the major biological and geological theories ensuring the coherence of the SVT discipline (O.P, 2007).
However, there are many lessons in which images of microscopic cellular observations can be integrated as an example, such as:

- Plant reproduction in 4th year of primary school: microscopic observations of pollen grains or the oosphere;
- Reproduction in animals in 5th year of primary school: microscopic observations of male and female gametes.

This absence means that the learner will not have the chance to manipulate and study microscopic observations until middle school, and in a way that is surprising, whereas it was necessary to think about early familiarisation of learners with these types of scientific images as early as primary school or even kindergarten (Clément, 1996) while adopting an intuitive approach consists in letting the learner express himself, questioning the problems of observing objects, or details of very small objects, by helping him or her to progress in his or her questioning and guiding him or her in the first answers to his or her questions that he or she will be able to find by him(her)self by manipulating lenses, microscopes, binoculars and preparations (ULG, 2007).

It may be that this lack of microscopic observation is reflected in the learner through the development of misconceptions about the cell or observations of rock structures and textures, which allows us to say that primary school textbooks in this case reinforce these misconceptions, and do not help the learner to broaden his or her cognitive field. It is important to start learning activities for children through a sensitive approach (seeing, touching, feeling, possibly listening) to the objects that learners will work on, because imagining or representing a "real" object is difficult for a child (Lamap, 2011). Everyone is currently aware that the current teaching of science is not producing the expected results. It is now widely acknowledged that current science education is not producing the desired results (El Batri et al., 2019). It is no longer a question of training only scientists but also of enabling the scientific acculturation of citizens living in a world where science and technology have a predominant place (Hassouni et al., 2014), hence the need to integrate microscopic observations and medical images from primary school onward, especially since human learning is a permanent construction process in which there are no stages of maturation characterised by specific faculties that can justify the introduction of precise knowledge at each stage. Teaching, therefore, is nothing other than helping pupils to progress by developing the quantity and quality of their conceptual networks; it is enabling them to access a greater number of concepts that they must structure and link to the field of knowledge (Benajami, 1994).

However, researchers have shown that schoolchildren have great difficulty imagining or picturing any object that is less than a millimetre in size. In primary school, the use of a magnifying glass (binocular) allows a first approach to objects that are too "small" to be distinguished with the naked eye. However, these tools do not make it possible to approach the atomic level of matter (Lamap, 2011). The results of the International Assessment conducted in February 1995 by the International Association for the Assessment of School Achievement (IEA), showed a deficiency in the achievements of students in science all over the world, towards this situation several countries have mobilised by adopting the investigative approach in order to develop a socio-constructor perspective, promoting exchanges between learners in order to build their own knowledge, but for this to be possible, he or she must acquire the basic notions at school, such as the concept of the cell, or structure of rocks, something that will allow him or her to easily cross scientific references during his or her investigation. (Hassouni et al., 2014).

Arriving at the pedagogical functions played by the three types of scientific images studied in textbooks: the illustrative function is the predominant one, whereas those with a heuristic or at least assessment function and which are recommended within the framework of the competency-based approach are only present in a small percentage, this raises problems in developing a certain autonomy of reflection in the learner, especially as heuristic teaching aims to make the link between the world of knowledge and that of practice (Boughanmi, Y, 2013). In this research context, knowledge is to be discovered from real-life issues that can be transposed into scientific images in textbooks. As knowledge is not in anyone's possession, teachers and learners set out to discover it on the basis of common knowledge, which the textbook must present in a problematic manner.

Faced with the exponential nature of change, it is now a matter of developing key competencies in the learner that will enable him or her to construct knowledge himself or herself according to his or her project, based on the information he or she finds both in the school context and in the media, cultural and intercultural environment in which he or she lives (kalason, 2007).

CONCLUSION

The main interest of this research is to have contributed to clarify the place of microscopic observations, magnifying observations and medical imaging and their functions in the Life and Earth Sciences textbooks.It should be recalled that the recent reform of the education system emphasises the development of skills and know-how such as observation, expression, criticism, research and synthesis. However, the dominance of the illustrative function of the three types of scientific images and the scarcity of those with a heuristic function as well as the absence of microscopic observations and medical imagery in primary school textbooks show that textbooks do not seem to be involved in this approach. Textbooks should therefore be constructed in such a way that they do not merely set out prescribed knowledge, but indicate didactic,

pedagogical and even anthropological approaches that make the school an institution for building knowledge, training citizens and communicating with others (Boughanmi, Y, 2013).

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