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Obstacles to learning physical sciences in moroccan college secondary school: the case of representations in optics

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Abstract : This research focuses on students' representations in optics. However, the rainbow, the eye, optical instruments and their operating principles, etc. all these elements surrounding the child in his daily life can explain why students already have representations even before having received scientific education, and we wonder how teachers in Moroccan schools go about making students assimilate the complex scientific phenomena that give rise to this field, especially in view of their initial representations, which can slow down learning . The choice of this theme led us to think about a crucial question: What can we do about students' representations in the field of optics?

To carry out this research, we developed a questionnaire which we distributed to 66 Moroccan secondary school students. The results of this study show the existence of false representations among students, which obliges physical science teachers to analyze the origins of these failures and find didactic and pedagogical means to correct them.

IndexTerms - Representations, teaching, learning, optics.

I. General introduction

Obstacles to learning, according to Cora Cohen-Azria(1), are like structures and modes of thinking that resist teaching and learning. For her, the obstacle should not be considered only from a purely negative point of view, because it participates in a certain intellectual functioning, in fact, this obstacle "... allows her to construct her thinking and gives her the impression of understanding.". She also adds that overcoming an obstacle means reorganizing an operation that can seem comfortable and effective to a learner.

Among these obstacles we find representations which are generally considered as systems of knowledge that a subject spontaneously mobilizes when faced with a question or a problem, whether or not these have been the subject of learning (REUTER and al .)(2).

The student never arrives in class with his head empty of knowledge; he has built up an entire explanatory system during his childhood to understand the world. This preconceived knowledge, whether more or less far from the truth, is functional and can therefore interfere with the teaching delivered in class.

In Physical Sciences teaching, the problem of representations occupies a primordial place (BOILEVIN)[3]. Thus, to the extent that the representations through which the student interprets physical phenomena are in contradiction with scientific models, research in Physical Science Didactics aims to construct educational interventions likely to promote the transition from the daily and spontaneous representation of phenomenon to a model compatible with the scientific concept.

However, today this primitive knowledge of the subject represents great resistance to scientific teaching as it is practiced at school. Thus, the construction of scientific concepts is not a process that can occur while listening to a presentation or reading manuals. It therefore seems important to have descriptions of possible changes at the level of thinking with reference to the learning conditions offered to students, as well as studies which would make it possible to assess the origin of the difficulties they encounter (WEIL-BARAIS)[4]. The teaching sequences themselves, just like the cognitive obstacles (MARTINAND)[5] can in fact produce difficulties. If, therefore, it seems today accepted that the subject does not understand an idea that if he is familiar with it, it remains for research in didactics to describe these processes of familiarization and concretization of abstract notions. With regard to the field of Physics, most researchers emphasize both the role of the observation approach during learning and the development of relevant guidance, likely to allow students to make inferences from new proposals. In a psycho-didactic approach, the reconstruction of the student's primitive representations cannot occur spontaneously.

Their destabilization requires didactic mediation implemented in the learning and teaching of specific knowledge contents (DUMAS CARRE)[6]. However, if a new concept responds to new situations with which the subject finds himself confronted, "this constructivism must take into account the conditions of social interaction in which the child's work is done and in particular the interaction of guardianship, the conflict with the “other, of language communication” (VERGNAUD)[7]. As has often been demonstrated by research focused on the representations of light and the effects associated with it by children aged 5 to 18, among a series of difficulties on the propagation and interaction of this physical entity with different objects, the main obstacle concerns the recognition of light as being a distinct and autonomous entity, independent of the sources which produce it and the effects it causes, existing in a certain region of space. According to authors who have studied this subject, this difficulty arises from the tendency of subjects to associate light exclusively with its source or with the visible effects it causes (OSBORNE)[8].

Nowadays, few teachers take students' initial representations into account when teaching, which explains why the learner only acquires an illusion of knowledge and it only slips to the surface. The student’s false representations then remain active and can even be reinforced. This is why it seems important to us not to neglect this question of preconceptions, which can explain certain blockages. Consequently, we must find ways to change these representations and establish sustainable teaching, which, ultimately, is an integral part of the work of the school teacher.

II. METHODOLOGY:

This research aims to identify the different types of academic representations of secondary school students in optics.

The methodology used by this research is in line with the collection of data through the use of questionnaires. we have prepared seven questions that relate to our subject of study; we used them all to develop our questionnaire.

So here it is; the seven (7) questions presented in the questionnaire:

- Why does a magnifying glass magnify objects?
- When you dip part of a ruler in a glass of water, they appear distorted. For what ?
- Why can we see ourselves in a mirror?

- You want to see an object placed in a dark room, what would you need?
- Why is the sky blue when it's sunny?
- Wet sand always appears darker than dry sand. Why?
- What is the light emitted by the sun like?

As we can see, the questions in optics are oriented towards three main themes: light, vision and colors.

This population brings together 66 students, the experiment took place towards the end of the year to have the maximum number of respondents, the questionnaire was distributed to students from the three levels of secondary school, because the aim was to extract the representations of students on their general knowledge but also on their scientific knowledge. Our research includes a quantitative analysis of the results since we work on the types of student representations. Thus, after compiling the data, we will use statistical tests to verify the different types of conceptions of secondary school learners regarding optics.

III. RESULTS AND DISCUSSIONS :

The results of this study are:

- 40% of students agree that the path of light deviates when it passes through water and that it is simply an illusion that makes us believe that the rule has become distorted , they also believe that the water exerts a force on the ruler causing its deformation and that the water makes the emerged part malleable.
- 35% of students agree that the reason we see ourselves in a mirror is that it is covered with a special product and that it looks like a puddle, as they believe the surface The smoothness of the mirror allows us to see ourselves in it.
- 65% imagine that the sky is blue because the air is blue in color. While more than 50% think the sky is blue; and that it is due to water vapor.
- 53% of students do not think that the light emitted by the sun is white or yellow while 52% of respondents believe that it has no color.
- 44% do not accept that this difference is due to the reflective power of wet and dry sand and that sand changes appearance when wet while 42% of students assume that this is due to the There is a substance in sand that turns dark when in contact with water and about 36% of respondents believe that water has a slightly blue tint that is acquired by sand.
- 43% of students think that a yellow object is visible in a room where there is no light.

These results show that secondary school students have a set of representations regarding the subject of optics of physical science seen in the second year of college, these representations can present an obstacle to their learning and to fully understand the consequences it is necessary to carefully analyze the origins of these failures. Depending on the nature of the questions asked of the students and the answers they provided, we can say that the causes of these false conceptions are:

- Books and textbooks offer formulations and models to explain scientific concepts, but sometimes these types of representations risk posing problems for readers.
- The difficulty of knowledge itself.
- At their school level, the students' knowledge and know-how are not developed enough to allow them to explain or understand complicated phenomena concerning optics such as: reflection, emission, absorption, ….
- During explanations, teachers trivialize scientific language so much that concepts sometimes lose their true meaning, consequently students learn false concepts.
- Poor management of the scientific or investigative approach during practical work causes an unstructured scientific vision.

The causes cited above present a challenge for the teacher and in order to minimize their effects on the teaching sequence, he is required to implement several teaching techniques, such as:

- Proper use of the scientific approach during lessons which will allow students to get used to chaining their ideas together in a logical way.

- Adopt the problem situation technique, because it will allow the teacher to extract all kinds of representations from his students and subsequently take them into consideration during his lesson.

IV. CONCLUSION :

School learning is an area where the contribution of representations is necessarily linked to the performance and results of students, which complicates the teacher's task and pushes him to look for educational methods and techniques to help students. to overcome and change their misconceptions.

It remains to be noted that students' representations are developed every day and every year, either in the good direction or in the bad direction. But the question that arises at this level: are Moroccan teachers in schools aware of the weight of their mission? Are they thinking of implementing an organizational strategy that sticks to students for the different subjects taught in general and for the physical sciences in particular?

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