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A Study of the Moroccan Students' Conceptions about the Four Aspects of Matter

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Abstract **– The study of the structure of the matter and the interpretations of its properties presents a very important part in literary sciences. The present work aims to investigate how Moroccan students conceptualize the concepts of the matter according to four aspects. The obtained results shows that a significant portion of students has several misconcepti--ons about the various aspects of the matter. Thus, the analyze of these obtained results allows us to propose some suitable techniques to detect students' conceptions in order to correct them during the learning processes.**

Keywords **– Moroccan Students' Conceptions; Matter; Physical Transformation; Chemical Transformation.**

I. INTRODUCTION

The scientific notion of the matter is omnipresent in the curricula of physical sciences in secondary schools in the Moroccan educational system [1]. Thus, a glimpse at the curriculum demonstrates that the idea of this subject remains a component in the program of the three years of university secondary education.

Half of this program is devoted to the module of physics and the environment in the program of the first collegial year. So, this module deals with concepts and themes related to physical states and their transformations also. Therefore, samples of particles are used to explain and interpret these physical transformations. The study of some phenomena of the learners' daily life is part of this approach, where water is taken as an axial example of acquiring the expected learning outcomes.

Since the physical sciences curriculum has been structured tardily, the second collegial year program is based on the notion of chemical transformations. The first module is entitled "matter and the environment". In this course, the air is considered as a very highly essential material for the combustions which constitute an important source of heat. It is fundamental to mention that the use of the particulate model of the air gives the possibility of introducing two concepts. The first one is the atom and the second is the molecule. Additionally, this axis is an opportunity to discover the importance of chemistry for the creation of new materials that do not exist in nature. This scientific process allows the Moroccan learners to open up on the economic and technological environment.

Towards the end of the curriculum of physical sciences, the axis of the collegial third year theme presents an extension of the concepts studied in the first two years with some new theories on the matter and its physical and chemical properties based on the atomic model of Rutherford. The second part of this course makes it possible to generalize the notion of chemical transformations with the study of the effect of air on metals and on organic matters. The lasts units are reserved to the discovery of some adverse effects of certain chemical reactions of the health and the environment of human being.

It is evident that the notion of the matter is evolving in a spiral way along the cycle of college secondary education. Teaching subject related concepts to college students requires them to have prior knowledge about these concepts during the previous years. A very great interest has been given to the conceptions of physical science by students during the past three decades. In particular, a significant portion of research has focused on students' perception of the subject [2-5]. The obtained results show that the students aged between (12-16 years old) encounter several difficulties during the learning activities of the subject. Students find it hard to acquire these new concepts due to their poor experiences with the materials in their daily life. These experiences often lead to a variety of misconceptions that hinder the development of a good understanding [6-10].

In order to identify and describe these misconceptions, many studies have been conducted to check students' understanding about the matter according to its different aspects [11-13]. Generally, we can distinguish between four aspects: the particular nature of the matter, chemical transformations, physical states and their transformations, and the conservation of the matter. However, in spite of these studies, additional efforts should be made to better understand how students develop an understanding of each of the four aspects of the matter.

The rationale of this article is to analyze the Moroccan students' conceptions about the four aspects of the matter. This article consists of three sections. The second section presents an overview about the methodology, target population and the questions raised about the subject. The third section describes the findings of this work.

II. RESEARCH CONTEXT AND METHODOLOGY

A. *Working Approach and Target Population*

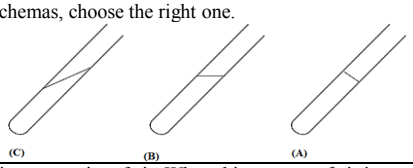
Analyzing how learners realize the conceptions of the subject's concepts may aid the teacher to plan the right learning scenario in a learning situation. Studying these conceptions requires a methodological plan that focuses on appropriate investigations. The methodology that has been chosen in this research is based on the use of multiple choice questionnaires. This type of questionnaires allows researchers to evaluate a considerable number of students who are under standardization conditions. It has been

purposed to study the perceptions of Moroccan college students about the notion of the matter because it presents an essential element in the curriculum of physical sciences. For this reason, a sample of 1000 first-year middle school students has been taken from the Casablanca- Settat region.

B. *Questionnaire*

This field research has been conducted for the rationale of analyzing the conceptions of the Moroccan collegial students concerning the four aspects of the matter. Therefore, the choice has been put on a questionnaire of 12 questions selected in a pertinent manner. Table 1 represents these 12 questions that cover the four aspects of the matter.

Table 1. Questionnaire with answer.

Aspect of the matter	Question	The right answer
The particular nature of the matter	Q1.1/ all liquids contain water a/ True. b/ False.	**b**
	Q1.2/ from the three schemas, choose the right one.  	**b**
	Q1.3/ A syringe contains a quantity of air. When this amount of air is compressed by a piston, its pressure a/ decreases b/ increases	**b**
Chemical transformations	Q2.1/ The vaporisation of water is a a/ chemical transformation b/ physical transformation	**b**
	Q2.2/ When heating a piece of ice, it is said that it a/ blends. b/ dissolves.	**a**
	Q2.3/ The dissolution of sugar in water is a; a/ chemical transformation. b/ physical transformation.	**a**
Physical states and their transformations	Q3.1/ The solidification of liquid water is a physical transformation. a/ True. b/ False.	**a**
	Q3.2/ The fog released during the boiling of water is water vapor. a/ True. b/ False.	**b**
	Q3.3/ When a bottle of water is removed from the refrigerator, drops of water are positioned on the surface of the water bottle. The origin of the air is a/ The water vapor in the air. b/ The existing water in the bottle.	**a**
Conservation of of the matter	Q4.1/ During the melting of a piece of butter, the mass . a/ conserves. b/ decreases. c/ increases.	**a**
	Q4.2/ During the freezing of water, the mass a/ conserves. b/ decreases. c/ increases.	**a**
	Q4.3/A syringe contains 3 grams of air. When this quantity of air is compressed by a piston, its mass a/ conserves b/ decreases c/ increases	**a**

III. Results and Discussion

A. *Results*

Students' responses have been compelled and then treated according to the four aspects of the matter. Graph 1 shows the results related to the aspect of the nature of the matter. The statistics of the questions' answers Q1.1 show that two-thirds of students know that liquids do not contain water, even though water is still a very abundant chemical species in nature. However, less than a third of students know that the free surface of a static liquid is horizontal.

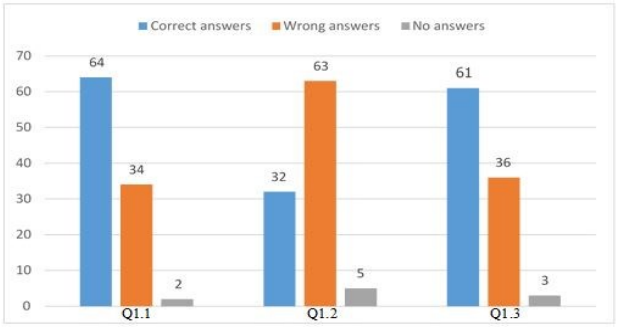


Fig.1. Comparison histogram of the questionnaire answers related to the first aspect of the matter.

As shown in Graph 2, the knowledge acquired in primary education has helped in having a very high rate of true answers to the questions presented in Q2.1. But unfortunately, the students' knowledge about the aspect of chemical relations implies that the rate of incorrect questions is high. The percentage of Q2.2 and Q.2.3 suggests 70%.

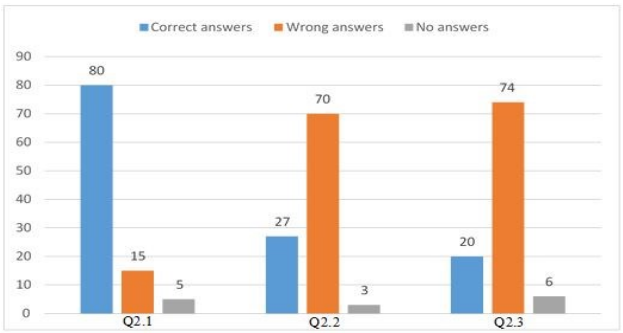


Fig. 2. Comparison histogram of the questionnaire answers related to the second aspect of the matter.

In order to study the conceptions of collegial students about the third aspect of the subject, the aspect of physical states and their transformations, graph 3 is represented in a

form of histogram to compare the replies of questions Q3.1 and Q3.2 and Q3.3. It is noticeable from graph 3 that the transformations from the liquid state to the solid one is normal and does not make any problems since the rate of true answers represents 85% of Q3.1. The responses rate of the questions 3.2 and 3.3 does not exceed 25%, which explains that the physical transformation to the gaseous state is often accompanied by misconceptions.

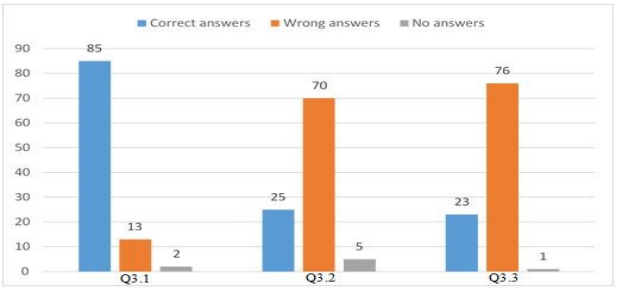


Fig. 3. Comparison histogram of the questionnaire answers related to the third aspect of the matter.

Finally, graph 4 describes a comparison between the rate of true and false questions that are to the pertained of the matter conservation. The results of this figure demonstrate that two thirds of students have answered the question Q.4.1. However, the answer rate of the last two questions is low. It does not exceed 35%.

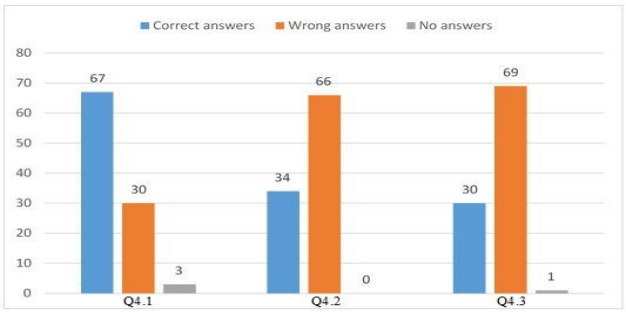


Fig. 4. Comparison histogram of the questionnaire answers related to the fourth aspect of the matter.

B. *Discussion*

The overview of the results obtained show that Moroccan students have several misconceptions about the various aspects of the matter. The findings imply that students' misunderstanding of these conceptions and errors emerge from their social background. Therefore, it is essential to take into consideration their perceptions in order to correct them during the learning processes.

On the one hand, students may encounter difficulties in studying fluids. Particularly, students have confusion between the properties of liquids and those of non-compact solids. This explains the reason for which the two third of the questioned people suppose that the free surface of a static liquid is not necessarily horizontal.

On the other hand, a very high number of students have not managed to distinguish between physical and chemical transformations. Thus, it is recommended to provide students with activities that give them the opportunity to discover the difference between the melting of a solid substance and its dissolution in a solvent.

The investigation on students' conception of physical states and their transformations show that students can easily evolve their ideas about the physical transformati--ons between the solid and the liquid states. Nevertheless, some barriers prevent students' progress in this field, accurately, their ideas about the physical transformations that are related to the gaseous state. For instance, students replace the fogged word by the term water vapor.

In the context of studying students' conceptions about the conservation of the subject, statistics introduce that students confuse between mass and volume. Students notice, daily, that the volume of the water increases during its freezing. This operation induces for students incorrect ideas which suppose that the mass water also increases.

Briefly, this field study helps in identifying students' conceptions of physics and chemistry. Students face some obstacles in dealing with them. Some actions must be taken to make them overcome the problems that they encounter in this field. The following table 2 demonstrates the obstacles that hinder students' learning process.

Table 2. Classification of the obstacle and the expected knowledge.

Obstacle	Type of obstacle	Expected knowledge
The confusion between fusion and dissolution	Obstacle of general knowledge : students always confuse between the fusion (physical transformation of a subject, under the effect of temperature) and the dissolution (chemical reaction between two substances).	- The solubility is the disappearance of a solute in a solvent in order to form a mixture called solution. - The fusion is a transformation of a substance from the solid to the liquid state under the effect of temperature.
The mass increases during freezing	Obstacle of general knowledge: Students confuse between the mass and volume (the volume of a substance increases during its freezing, so students believe that the mass of the substance increase)	- Conservation of the mass during the change of the subject state. - Mass and volume are two different physical quantities.
The mist emitted during the boiling of the water is the water vapor	The linguistic obstacle : Students always replace the term fog (the liquid state) by the term water vapor which is invisible.	- The steam released during the boiling of the water does not represent the water vapor in the gaseous state.

IV. CONCLUSION

The concept of matter is axial in the in the curricula of physical sciences in secondary schools in the Moroccan educational system. In this context, we have detected and analyzed the conceptions of moroccan students about four aspects of matter

The outcomes of this study imply that these Moroccan students have ideas about different aspects of the matter. The contribution of this research has put the emphasis on these conceptions in order to detect the main difficulties that prevent the evolution of students' acquisition. Students' false ideas can be classified into two types. First, students often confuse between chemical and physical transformations. Second, students also confuse between the mass of a substance and its volume. These confusions can lead to a false interpretation to some physical transformations.

In summary, teachers have to interact with the false representations of students using the method of "to do with so as to go against" [14]. This method suggests that teachers should take into consideration these conceptions in order to give students the opportunity to progress and evolve. In this case, students should realize that their conceptions are wrong. Also, teachers should lead students to formulate other realistic conceptions.

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