

## **Difficulties inherent in acquiring the Atom concept in the freshman of university**

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### **Abstract:**

*This paper report on the qualitative study, which examines the cognitive difficulties of the first-year students with the concept atom, covered in the first semester course general chemistry I and whose basic elements were studied in high school, the equivalent of which in Morocco is secondary education qualifying*

*The aim of the present study is to try tounderstand and define the origin of the epistemological obstacles to learn the concepts of atomistic by 1st year students and to suggest some solutions to make knowledge more attractive and the transition between high school and the university most successful.*

*The study focused first on analyzing the examination results of the atomistic' module at the 1st university semester then we developeda test on the basic prerequisites of atomistic studied in high school.*

*we note that learning was done in Arabic in high school and in French in university, the reason why we opted for the test in Arabic in order to reduce the impact of language and respecting appropriate vocabulary developed inhigh school.*

*The results show gaps in knowledge construction at the secondary and university level. Learning is destitute of meaning which does not facilitate the learning of abstract concepts. We note that socio-cultural and socioeconomic factors were identified too.*

**Key Word:** *Atomistic, Atom, Epistemological obstacles, Transition High school-university, constructivist approach*

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### **I. Introduction**

The course of the atomistic module which studying in the 1'st half of the first year of Matter Sciences Physics Chemistry (SMPC) option require the knowledge studies at the high school. The semi-directed interview with the responsible for the atomistic module at the faculty level where the study was carried out and the analysis of statistics, relating to the rate of students in the 1st year of the Mathematics, Physics and Chemistry Section (MPCS) having validated the said module in the 1st semester reflect learning difficulties that the teacher explains by gaps in the basic knowledge supposedly acquired in high school and the lack of mastery of the French language.

Certainly, the built of new learning depends on the appropriation of prior knowledge as a process and on the individual's constructions of meaning<sup>1</sup>, however, the constructivist paradigm depends also on the learning conditions as curriculum, the teachers practices and our representations of learning<sup>2</sup>.By the wayseveral studies<sup>3,4,5,6,7</sup> on mathematics and sciences learning showed that the constructivist-based instructional seem to be more effective than the conventional teaching method. Such approach is helpful when learning involves conceptual change. The latter process, as pointed by Stofflet and Stoddart<sup>8</sup>, enables the questioning of prior knowledge, a conflict that leads to the adaptation of the structure of pre-existing knowledge.In addition to these constraints, the first year of university is a critical transition stage that induces major changes in the students' educational environment and can be impacted by their social, cultural and economic conditions.

In relation to knowledge mobilization, it certainly depends on the extent of mastery of this knowledgein the source situation, but also on the meaning one gives to the learning, the understanding of the target situation and the reason why one calls upon such knowledge acquired in the source situation in such a target situation<sup>9</sup> (Forcier and Goulet, 1996). Hence the importance of organizing and structuring this knowledge<sup>10</sup> (Moffet, 1993), which allows students to access the knowledge to be mobilized and to use it wisely in a new task or new learning<sup>11</sup> (Presseau, 2000). It is therefore a work of the mind, which involves observations, hypotheses, interferences, analogies, comparisons and other cognitive and metacognitive operations<sup>12</sup> (Perrenoud, 2000). This requires the preparation of learners for transfer activities and therefore appropriate didactic treatment by teachers<sup>9,13</sup> (Forcier & Goulet, 1996; Lauzon, 2000).

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It is in this logic that we had constructed our research, with a view to identifying the difficulties inherent in the mobilization of basic knowledge related to the "Atom" concept tackled in high school and the construction of new learning programmed in the Atomistic I module in the university. This choice is motivated by the fact that only 45% of the students were able to validate the module (with a score of more than 10/20) during the 3 consecutive years concerned by the analysis.

We supposed that learning disabilities are due to gaps in basic knowledge studies in high school, to the understanding of the concept "Atom" at the university level, to the learning strategies adopted by students, and the learning approach changes imposed by the transition from high school to undergraduate studies

## **II. Material And Methods**

This research is based on an exploratory, descriptive and qualitative approach. The study was carried out on a sample of freshmen students 'volunteers of Mathematic, Physic and Chemistry Section (MPCS) in a science faculty in Morocco. The study began with an analysis of the curricula from secondary school to the first year of the MPCS, in particular the Specific Pedagogical Orientations of Physical Sciences in middle and high school as well as the textbooks and documentation of the atomistic module of the first year of the university. The objective was to identify the basic knowledge mobilized in the construction of new learning in the first year of the MPCS. Then, we developed a written test from the results of this analysis and was administered to a sample of 253 student volunteers.

Given that most teachers consider the weak level of the majority of students in French to be one of the major handicaps to learning in the university, the investigation tool was made in Arabic while conforming to the terminology adopted in the high school curriculum so as not to accumulate difficulties.

The instrument was validated by three experts one from the Faculty of Education and two from the science faculty. Their comments and modifications have been duly made in order to ensure the validity of the form and content of the instrument.

The test is composed of 8 items covering the basic elements necessary for the development of learning related to the Atom concept and the Slater rule that the students have already studied during the first semester of the first year. To these items, we have added open-ended questions (so as not to influence their answers) in order to identify the elements that can shed light on the constraints related to the learning context of Atomistic, the views of the subjects of the experiment, on the origin of learning difficulties and on the relevance of teaching this concept as well as their suggestions to promote quality learning. In order to find out the teachers' point of view on the results obtained, we organized focus groups with university teachers in the form of a semi-directed interview.

## **III. Result And Discussion**

### **III.1 The results of the curriculum analysis**

The analysis of the curricula shows that the "Atom" concept is built according to a progressive and spiral approach that takes into account the specificities of the learners. The transfer of knowledge takes place within the same level or from one level to another, within the same cycle or from one cycle to another. In the last year of the cycle, the constituents of the atom, the atomic number of a chemical element and the concept ion which will be mobilized in the first notions of electrical conductivity in aqueous solutions is introduced, programmed in the same year and developed in the common core. However, the symbolic representation of the nucleus of the atom, the electronic layers of atoms and ions as well as the electronic structure will be tackled for the first time at the common core. The same applies to the periodic table, its applications and isotopes. Rutherford's experiment highlighting the lacunar structure of the atom introduced at the common core will be exploited and developed at higher levels.

The knowledge related to the atom concept is mobilized, in the 2nd year bachelor's degree, in the chapter of nuclear physics and in the last physics course aiming at sensitizing the learners on the limits of Newtonian mechanics to explain the energy levels of an atom and consequently prepare them for the new learnings that will be developed in the 1st year MPCS.

### **III.2 The results of the written test**

#### **□ Basic knowledge related to the "Atom" concept**

Analysis of the results of the written test shows (table 1) that the majority of the subjects could not define correctly the atom.

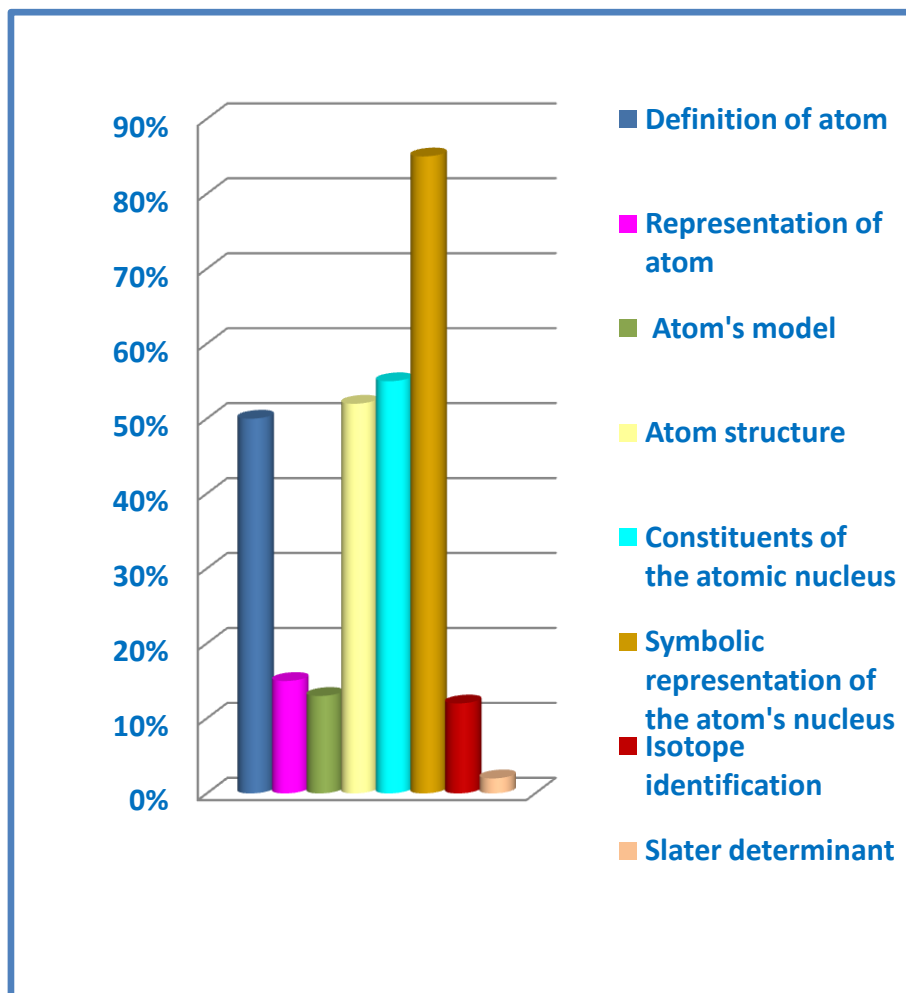


Table no 1: Results of writing test

These results seem to show that the majority of students don't master the prerequisites necessary for the implementation of teaching-learning related to the Atom concept at the university level. It is worth remembering that the test was carried out at the end of the 1st academic semester and therefore the students finished the Atomistics I module and that the written test administered to the students focused on the basic elements already covered in high school. The discussions with the teachers of the atomistic module I confirm its results and specify that they are not responsible for the low level of the students and that it is difficult to build new learning if the concerned have difficulty in mobilizing their previous knowledge. In order to mobilize knowledge, it is imperative to acquire it first, but it is also important to give meaning to what is learned.

**Context for learning the concept**

The majority of the students, state that they find difficult to assimilate the basic elements of the concept "Atom" because of its abstract aspect and the way it is taught. They feel that the teachers' approach is based on the quantity rather than the quality of learning. Other factors were cited by students, which we categorized as follows:

Language and vocabulary used	<ul style="list-style-type: none"> <li>✓ Week level in the language learning</li> <li>✓ low bilingual vocabulary (middle and high school)</li> <li>✓ High French vocabulary using by the university teachers in oral communication/exam</li> </ul>
Learning strategies	<ul style="list-style-type: none"> <li>✓ Paradigm teaching/paradigm learning</li> <li>✓ 90% estimate that courses are not exhaustive</li> <li>✓ 80% stated that they have difficulties to work autonomous</li> <li>✓ 98% are unable to make learning sense</li> </ul>
Social life changes	<ul style="list-style-type: none"> <li>✓ Instability situation</li> <li>✓ Autonomous at personal, organizational and financial levels.</li> <li>✓ Poverty</li> </ul>

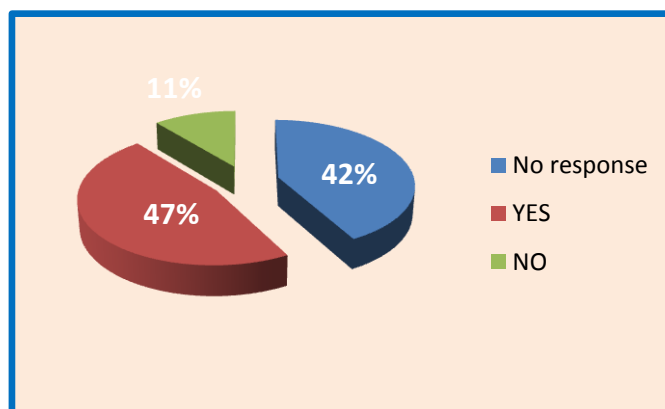
Table 2: language, strategies learning and socioeconomic factors

- **Language and vocabulary used:**the most of student cited French language as obstacle to the learning due to their low level that teachers doesn't take in consideration and use high level French during the course and in writing exam.However, the French language is taught as a first foreign language since primary school and physical science teachers are expected to develop a bilingual scientific vocabulary via a dedicated glossary.
- **Learning strategies:**The largest part of students views the approaches adopted by teachers as being more in accordance with the teaching paradigm rather than the learning paradigm and the courses are not enough developed by the teachers in the university. So, in this context, it's difficult to make sense of learning Atom concept or others and developing autonomous to learn. this last skill should be developed from elementary school, then middle school and high school.
- **Social life changes:**The students who are forced to move to the city for their higher education indicatethat they have difficulty adapting to the resulting changes.This move requires additional burdens beyond their parents' financial capacities, which makes their situation unstable and prevents them from concentrating on their studies, especially in the first semester of the first year of university.Apart from the financial side, they are forced to take charge of themselves at the organizational level even though they have not been prepared to be autonomous.

Semi-structured interviews with university teachers on these results reveal an awareness of the current state of affairs, except that they decline all responsibility in this regard because of the module's dense curriculum in relation to the time allotted to its teaching in addition to the very low level of mastery of the French language, the language of learning. In this regard, it is important to note that a French language positioning test is systematically done for first year students and that a remedial course is scheduled, but according to the interview with the professor in charge of this support course, few students are assiduous. These data as expressed by students cannot support effective learning with meaning.

#### □ **Pertinence of learning of the "Atom" concept**

Concerning the relevance of learning the concept "Atom", 47% of the subjects as shown in the table 3, affirmed the interest of learning this concept and its role in the universe. Concerning the relevance of learning the "Atom" concept,



**Table 3: Pertinence of learning of the "Atom" concept**

However, those who answered no (11%) consider that its abstract aspect and the way it is taught make learning it meaningless and consequently the student does not understand its usefulness. 42% of students did not answer this question.

This recognition of the interest of learning atomistic is useful but not sufficient to build new learning. Indeed, the factors cited by the students, whether they are cognitive, didactic, social or economic, can only hinder the realization of learning.

#### □ **Student suggestions and recommendations**

- ✓ Unification of the language of learning (either Arabic or French) from primary school onwards.
- ✓ Adoption of constructivist approaches and the teaching-learning paradigm.
- ✓ Programming of practical work and simulations in order to overcome the abstract aspect of the "Atom" concept.
- ✓ Teachers take into account the impact of the changes induced by the transition from secondary school to the first year of university on a cognitive, social and personal level.

#### IV. Conclusion

The results of these various studies show difficulties in mobilizing knowledges from one level to another within the same discipline. The results shows that the learning difficulties seem to emanate from:

- ✓ Lack of mastery of pre-requisites supposedly mastered in secondary school and which are necessary for the development of new learning.
- ✓ The inability of students to manage the changes induced by the transition to university in terms of learning strategies, autonomy and language of learning.
- ✓ Lack of financial resources.

In fact, the statements of the subjects seem to show that learning difficulties are not only due to the shortcomings of the students accumulated during the secondary education cycle but also to the teaching strategies at the university level and their socioeconomic conditions as well as the lack of support of the students in the transition stage from the secondary to the university cycle.

This study validated the 4 hypotheses of the research:

- ✓ gaps in basic knowledge studies in high school
- ✓ understanding of the concept "Atom" at the university level
- ✓ the learning strategies adopted by students
- ✓ learning approach changes imposed by the transition from high school to undergraduate

to which was added the socio-economic dimension of the students that we had not anticipated in this study.

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