

## **CHEMISTRY TEACHING, 'SCIENTIFIC ILLITERACY' AND 'FUNCTIONAL ILLITERACY' IN BRAZIL**

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### **ABSTRACT**

In the present work, an analysis of the quality of the students who arrive at the Brazilian federal public universities in the last ten years is made, based on basic chemistry classes for the chemistry, chemical engineering and pharmacy courses. In the last ten years, "scientific illiteracy" as well as "functional illiteracy" have only increased, making it possible to establish (as a general trend) a dire prognosis for the quality of graduates of chemistry courses in Brazil. [*African Journal of Chemical Education—AJCE 10(1), January 2020*]

## **INTRODUCTION**

With a thirty-year classroom experience, twenty-one of these as a university professor, I have noticed, year after year, a drop in the quality (in terms of high school education) of students coming to university.

I can only talk about the Brazilian reality (the only one I know closely) but, I believe, some of the facts and reflections pointed out in the present work may be part of the reality also of some other countries of the so-called "third world".

The data presented here refers to the period 2009-2019, ie the last ten years.

## **METHODOLOGY**

From 2009 to 2019, each semester, two classes of basic chemistry subjects (from undergraduate courses in chemistry, chemical engineering and pharmacy courses) were chosen as the "object of study", with a total of approximately 600 students.

In each of the applied assessments (three per semester), questions regarding the content of high school chemistry were applied.

## **RESULTS AND DISCUSSION**

Currently in Brazil, students are admitted to Federal Public Universities through the "National High School Exam" (ENEM). This is, in my view, a low-quality exam, which has greatly contributed to the deterioration in the quality of chemistry teaching (and teaching in general) in Brazilian secondary schools, since secondary schools (both public and private) have as their main goal the placement of students in universities.

In the last ten years, it is sensible (regardless of the survey of quantitative data) the deterioration in the quality, in terms of education, of students arriving at universities.

To the scientific illiteracy (which already existed, and only worsened in recent years) is now added the functional illiteracy (ie, the student "reads" texts, but does not really know how to interpret them).

Many (most) students are reported to have difficulties relating to the chemistry content before having difficulties with the Portuguese language: they have difficulty interpreting correctly a three to five line text (such as the statement of a chemistry problem, for example).

As a quantitative data, it can be pointed out that of the high school chemistry questions applied in exercise lists or even applied in some tests, about half of the students miss at least 50% of them.

Even basic contents such as chemical formulas and acids and bases constitute "challenges" for most students.

Needless to say, a deterioration in the quality of students entering college ultimately results in a decline in the quality of teaching, since in teaching, as in chemical kinetics, the slowest step determines the speed of reaction.

Leaving aside the greater workload and stress of teachers (who have more work to teach even basic content), it also increases the number of students' reactions to teachers (since the student cannot understand that "the problem "not the teacher, but him).

As noted earlier [1], the (generally) poor quality of scientific education in Brazil can be unambiguously pointed out based on international examinations such as the Program for International Student Assessment (PISA). It seems that, as a general trend, results tend to worsen or, at best, remain stationary.

It is noticeable (not only by correcting the questions posed in the tests) but mainly during class that for most students there is nothing that can really be called scientific knowledge. All their "knowledge" is a "patchwork" of equations and "tricks" on how to solve typical questions without any real notion of science or technology.

It seems that little (or nothing) has changed since 1951 when Richard Feynman visited (and served as a visiting researcher for six months) Brazil and commented on a group of college physics students [2]:

*In regard to education in Brazil, I had a very interesting experience. I was teaching a group of students who would ultimately become teachers, since at that time there were not many opportunities in Brazil for a highly trained person in science. These students had already had many courses, and this was to be their most advanced course in electricity and magnetism--Maxwell's equations, and so on. The university was located in various office buildings throughout the city, and the course I taught met in a building which overlooked the bay. I discovered a very strange phenomenon: I could ask a question, which the students would answer immediately. But the next time I would ask the question--the same subject, and the same question, as far as I could tell--they couldn't answer it at all! (...). After a lot of investigation, I finally figured out that the students had memorized everything, but they didn't know what anything meant. (...).*

*After the lecture, I talked to a student: "You take all those notes what do you do with them?" "Oh, we study them," he says. "We'll have an exam." "What will the exam be like?" "Very easy. I can tell you now one of the questions." He looks at his notebook and says, " 'When are two bodies equivalent?' And the answer is, 'Two bodies are considered equivalent if equal torques will produce equal acceleration.' " So, you see, they could pass the examinations, and "learn" all this stuff, and not know anything at all, except what they had memorized.*

It is also noticed that students take the expression "attend classes" to the letter: really, they just attend the class, do not (want) to participate. If the teacher proposes a list of exercises, the students want him (the teacher) to solve it, and that they will only have to "memorize" the list, in the expectation that something very similar (in fact, identical, with just some different data) is applied to the exam. This is the mindset of "college students" in basic chemistry (and other science) courses in Brazil. Once again, paralleling Feynman's experience [2] is inevitable:

*(...) I taught a course at the engineering school on mathematical methods in physics, in which I tried to show how to solve problems by trial and error. It's something that people don't usually learn, so I began with some simple examples of arithmetic to illustrate the method. I was surprised that only about eight out of the eighty or so students turned in the first assignment. So I gave a strong lecture about having to actually try it, not just sit back and watch me do it.*

As a general conclusion, one finds that the main problem of chemistry education (and scientific education in general) in Brazil is not of an economic, material nature, but of an intellectual / spiritual nature: the "primitive" mentality of students (and, unfortunately, many teachers, too).

## REFERENCES

1. H.H.X. Rocha, D.de S. Dantas, R.F.Farias, Contextualization and interdisciplinarity in chemistry teaching in Brazil: After two decades, everybody knows but nobody understands, AJCE, 2017, 7(1), 31-36.
2. R.P. Feynman, Surely You're Joking, Mr. Feynman! - Adventures of a Curious Character (as told to Ralph Leighton), Bantam Book, New York, 1985.