

## HOW FRENCH STUDENTS USE THE LANGUAGE OF CHEMISTRY

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The chemist should learn to handle symbols and formulas (Laszlo, 2011), part of the language of chemistry, which has to be done in connection with the other areas of chemical knowledge, the macroscopic and microscopic ones (Johnstone, 1993 ; Kermen & Méheut, 2009; Taber, 2013; Talanquer, 2011). We wonder whether the students are able to make proper links with the macroscopic or the microscopic models when they use chemical names and formulas. According to our analysis of the curriculum, this topic is not covered at the moment in the teaching of chemistry in France, but we think that the students' difficulties concerning the use of the language of chemistry might be important. We conducted an investigation to find out what mastery of the language of chemistry French students have. We particularly wanted to determine whether they are able to properly associate characteristics of the macroscopic level (pure substance or mixture) and of the microscopic level (atom or molecule) to a name or/and a formula. We administered a paper and pencil test composed of two multiple choice questions to students (N=603) who have been learning chemistry for 2 years (age 14) and others for up to 7 years (age 19, first year university). The students are asked to choose one or more criterion among four (pure substance, mixture, atom, molecule) that they could associate to a name (question 1) or a formula (question 2). The students surveyed are not able to correctly associate with a name or a formula (table1), both macroscopic (pure substance or mixture) and microscopic (atom or molecule) criteria. However, the number of correct answers on the microscopic criteria improves with the number of years of study. Analysing the answers in depth shows that the students particularly struggle to associate macroscopic criteria to the names as well as to the formulas. The students do not seem to master the concepts of pure substance and mixture (Stains & Talanquer, 2007). Less than a quarter of the students in group 3 (age 17-18, N=147, students studying science in depth) answer correctly and more than 60% do not answer at all. These results confirm the need to offer teachers new didactical tools to develop the teaching of the language of chemistry.

**Table 1** Example of percentage of correct answers for each formula and by grade levels

Correct answers	C	H <sub>2</sub> O	O <sub>2</sub>	CO <sub>2</sub>	Fe	C <sub>2</sub> H <sub>6</sub> O
Students' group and age						
Group 1: age 14-15 (N = 233)	13%	6%	15%	5%	7%	2%
Group 2: age 16 (N = 178)	29%	8%	15%	3%	25%	2%
Group 3: age 17-18 (N = 147)	22%	12%	16%	6%	22%	4%
Group 4: university (N = 45)	49%	16%	33%	4%	36%	7%

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