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MISCONCEPTION IN CHEMISTRY TEXTBOOKS AND TEACHERS AS USERS: CASE STUDY ON THE CONCEPTS OF QUANTUM NUMBERS AND ELECTRONIC CONFIGURATIONS

Kristian Handoyo Sugiyarto, Heru Pratomo and **Rr Lis Permana Sari**
Yogyakarta State University, Indonesia

Chemistry textbooks for senior high school commonly used by chemistry teachers as well as students have been reviewed on the concepts of quantum numbers and electronic configurations. A number of six textbooks and thirty teachers from fifteen senior high schools were taken as samples. Typically common misconceptions were found on the authors as well as the teachers. For quantum number ℓ=1, the ordering of *m*ℓ: -1, 0, +1 is wrongly associated with alphabetic ordering of p orbitals: p_x, p_y, p_z, within five of the six textbooks; while the other one mistakenly stated that it is immpossible to know the relationship beween the two, and thus cartesian-axes labels are just arbitrarily. In accordance to Hund's rule, five of the six books stated that the unpaired electrons are always to be (m_s) of +½ (spin-up,), while the rest stated that it might also be (ms) of -½ ( ). In writing electronic configurations of elements for all textbooks it is always governed with aufbau principle due to increasing (*n+ℓ*) of Madelung. In the case of (3)*d* block, [Ar] $4s^{(1-2)}$ $3d^{(1-10)}$ electronic configurations were favored in all textbooks, though four of them stated that [Ar] $3d^{(1-10)}$ $4s^{(1-2)}$ were also allowed. Thus, an odd statement appears that electronic configuration could be written in two ways. Three textbooks introduced the terms of the last and the *n*th electron to be associated with the corresponding quantum numbers, and this leads to serious further misconceptions. No statement was found that the ordering of (*n+ℓ*) pattern is actually only true for the first twenty elements. Similar misconceptions were also observed for teachers. Only seven teachers stated that the unpaired electrons can be either (m_s) +½ or (m_s) -½, however, all teachers always take (m_s) +½ as the correct answer. Nine teachers stated that the energy of 3d orbitals is lower than that of 4*s*, but the electronic configurations of transition elements were written as [Ar] $4s^{(1-2)}$ $3d^{(1-10)}$. Thus, eventhough some teachers seems to have different idea with the textbooks, they are inconsistent. It might be suggested that the chemistry textbooks must be revised to the correct concept by introducing the solution of Schrödinger equation and the correct order of energy of orbitals as observed by photoelectron spectroscopy.

Biography

Kristian Handoyo Sugiyarto gained his Drs. degree from Yogyakarta State University (UNY), Indonesia in 1978; while appointed to the academic staff of UNY (1979), he undertook MSc program in 1984-1987, and then continued to the PhD program in 1989-1992, both at the Department of Inorganic Chemistry, the School of Chemistry, UNSW, Australia, under the supervision of Prof. H A Goodwin. He then undertook a three-six-month Post-Doctoral research, again with Prof. H A Goodwin, 1995-1997. He has more than 20 international publications dealing with spin-crossover in iron(II) and some education were published in various international journal Scopus indexed, while more than 15 articles publised in local-national journals. He also undertook another six-month research in structural study by EXAFS analysis with Prof. Makoto Kurihara at Shizuoka University and with Prof. Saito A at Tokyo Gakugei University, 2002-2003. He also undertook a four-month academic recharging program for doing palladium complex with Prof. Stephen B Colbran at the School of Chemistry, UNSW, Australia, 2009-2010. He has also presented in several international conferences in Paris, Rome, UPSI Malaysia, and Bangkok, Thailand.

sugiyarto@uny.ac.id