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AN ANALYSIS OF PRE-SERVICE CHEMISTRY TEACHERS MISCONCEPTIONS IN SYMBOLIC LEVEL OF STOICHIOMETRY

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In *situ* generated fluorescent gold nanoclusters (Au-NCs) are used for bio-imaging of three human cancer cells, namely, lung (A549), breast (MCF7), and colon (HCT116), by confocal microscopy. The amount of Au-NCs in non-cancer cells (WI38 and MCF10A) is 20–40 times less than those in the corresponding cancer cells. The presence of a larger amount of glutathione (GSH) capped Au-NCs in the cancer cell are ascribed to a higher glutathione level in cancer cells. The Au-NCs exhibit fluorescence maxima at 490–530 nm inside the cancer cells. The fluorescence maxima and matrix-assisted laser desorption ionization (MALDI) mass spectrometry suggest that the fluorescent Au-NCs consist This article surveys and investigates pre-service chemistry teachers' misconceptions in stoichiometry at the symbolic level, and possible solutions to address those misconceptions. Students and teachers broadly acknowledge the importance and difficulty of stoichiometry. Available research, meanwhile, also broadly acknowledges misconceptions at the symbolic level. In an effort to investigate associated misunderstandings, and to search for possible solutions, research was performed in Thai pre-service teachers. Fourteen Thai pre-service second year chemistry students participated. Three questions at the symbolic level of stoichiometry were presented asking students to solve by written explanation. One-on-one interviews were conducted. 72% of pre-service chemistry teachers were not able to solve the problems because they had multiple misconceptions such as: misconceptions about the formula related to chemical bonding; misconceptions about the chemical equation and; misconceptions about the calculations and mathematics. The written testing and interviews revealed that art of the problem is that a strong foundation in mathematics and chemistry is important and related to solving the problem of stoichiometry at the symbolic level. At a deeper level, the misconceptions appear to relate to the abstractness of stoichiometry at the molecular level and symbolic level. To be effective, and meaningful, teachers should apply the so-called three levels of thinking carefully integrating and linking the macro, molecular and symbolic levels to teach students in the classroom. In the process, teachers must initially check the students' prior knowledge because students must be able to link prior knowledge such as how to write chemical formulas, how to balance chemical equations, and how to do stoichiometric calculations. In short, what is proposed is a holistic and integrative approach applying the multiple levels of chemistry with careful consideration of the students' prior knowledge.

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