



A STUDY OF THE PROBLEMS FACED

BY

G.C.E. (A/L) STUDENTS IN CHEMICAL CALCULATIONS

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ABSTRACT

Chemical calculations are widely used in many disciplines such as industries, laboratories, educational institutions. These are used in the field of education to empower the students' ability of applying the chemical concepts along with the mathematical concepts to solve problems, which involve numerical calculations. These problem based chemical calculations would also improve the students' thinking ability and skills of logical intelligence. As such these chemical calculations are also used in assessing students in the learning process.

However, it has been found that the achievement levels of students in chemical calculations at G.C.E. (A/L) examination is considerably low. As such, this study was aimed at finding the problems faced by the students in chemical calculations. In this study question papers on chemical calculations and mathematical calculation were constructed and validated. These instruments were administered to a sample of 140 Grade 13 students selected from two provinces depending on the availability of students and the number of variables of the study. However, the results of 120 students were selected for the analysis by considering only those who were present at all the tests conducted. Students only from two provinces were selected due to the readily accessibility, the willingness of these school authorities to allow the students participate in this study to obtain a reasonably representative sample. Student sample included students from National Schools and there were 52% biological science students in the sample. Students, school teachers and national evaluators of G.C.E. (A/L) Examination were also interviewed to get their opinion on chemical calculations.

Statistics such as mean values, Spearman rank correlation and two sample t-test (confidence interval 95%) have been used to analyze the student performance. Students' average marks for mathematics paper was 55.26% where as the average mark for the chemical calculation paper was 42.5%. Many students had made mistakes in addition (43.3%), subtraction (27.5%), multiplication (70.8%), division (83.3%), indices (47.5%),

logarithm (56.7%). Students have also made mistakes relating to the chemical concepts and principles such as atoms (35.7%), molecules (21.4%), molecular formula (17.9%), moles (8.9%), molarity (35.7%), molality (60.7%), mole-fraction (7.1%), stoichiometry (42.9%), Hess's law (32.1%), Born-Haber cycle (22.6%), gas laws (57.1%), Raoult's law (10.7%), pH, K_a , K_b , K_{sp} (75.0%), electrode equilibrium (25.0%), inorganic reactions (51.2%) and chemical kinetics (14.3%). More than 20% of students didn't complete calculations. The Spearman rank correlation coefficient of 0.524 showed that a positive correlation exists between the mathematical achievement and the chemical calculations achievement of the students. Students (25%) have expressed that applying chemical concepts along with mathematics is the major problem in doing chemical calculations. Teachers and national evaluators had the opinion that students find difficulties in simplifying sums and linking the knowledge of chemistry along with mathematical concepts.

As a part of this study the students were given the chemistry calculations paper in two format as structured and unstructured questions. It was found that the average mark of the students for structured questions is higher than that for unstructured questions. This could be due to the guidance provided through the structured questions to reach the final answer compared to the unstructured questions. As such the real problem solving skills of the students could be assessed through the unstructured questions where students have to think and find the way of solving the problem. Although, due to the perceived differences in facilities and student achievement levels, we expected a difference in performance of the students in the two provinces in chemical calculations there is no significant difference between the two samples according to the two sample t-test which gave the p-value 0.122. However, there is a significant difference in performance of the students in the two provinces for the mathematics paper which had the p-value 0.040 according to the two sample t-test.

The above findings suggests that existing chemistry classroom practices need to be re-evaluated with a view to using more appropriate teaching/learning methodologies and strategies to improve students' logical intelligence and the practice of the usage of mathematical functions for chemical calculations.