Methodology of students' constructive learning activities in teaching the theme of chemical equilibrium

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One of the problems in the teaching process of chemistry is the process of working out new teaching methods that meet the learning difficulties in the field of chemical kinetics. Proper mastery of chemical kinetics requires students to have a conceptual understanding of the dynamic side of chemical theory, and constructive learning contains its basis. The following principles should be used in the teaching process: knowledge must be acquired and mastered independently, productively and creatively; logical, critical and creative thinking, as well as problem-solving and decision-making skills should be formed. We illustrate this on the example of chemical reactions proceeding in both directions (straight and reverse). Under certain conditions, a chemical equilibrium occurs. For example:

$$CH_3COOH + CH_3OH \leftrightarrow CH_3COOCH_3 + H_2O \qquad (1)$$

Chemical equilibrium is a continuous and time-independent state of a reaction system which is characterized by a constant at a given temperature.

For a general chemical reaction $aA + bB \Leftrightarrow cC + dD$

$$\frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b} = K_C\ [(mol/l)^{\Delta\nu}]; \qquad \frac{p_C^c \cdot p_D^d}{p_A^a \cdot p_B^b} = K_p\ [kP_a^{\Delta\nu}] \qquad (2)$$

$$\Delta\nu = (c + d) - (a + b) \qquad (3)$$

where we used molar concentrations (C, D, A, B), reactions coefficients (a, b, c, d) and partial pressures (p_C, p_B, p_A, p_D).

During the chemical equilibrium with $\Delta\nu = 0$, the amount (mol) of all the substances involved in the reaction can be written according to the law of mass action. The law of mass action equations can be derived from kinetics and thermodynamics. According to the equation (1)

$$K_C = \frac{[CH_3COOCH_3] \cdot [H_2O]}{[CH_3COOH] \cdot [CH_3OH]}; \qquad K_C = \frac{\nu[CH_3COOCH_3] \cdot \nu[H_2O]}{\nu[CH_3COOH] \cdot \nu[CH_3OH]}$$

But for the equation $N_2 + 3H_2 \Leftrightarrow 2NH_3$:

it will be: $K_p = \dfrac{P^2(NH_3)}{P(N_2) \cdot P^3(H_2)}$

We came to a conclusion that, methods for developing constructive abilities, which form the basis of learning theory in students in the direction of teaching and understanding the relationship between quantitative and qualitative aspects of chemical kinetics, must be carefully elaborated.