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COMPARISON OF TRADITIONAL AND CRITICAL THINKING APPROACHES IN TEACHING NEWTON'S SECOND LAW

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The aim of this study is to compare traditional and critical thinking-based approaches in teaching Newton's second law and to justify the effectiveness of the critical approach in developing students' understanding of physical concepts, independent thinking, and analytical skills.

In teaching physics, the traditional approach mainly focuses on delivering ready-made knowledge and solving problems based on formulas, with students often assimilating knowledge mechanically. When teaching Newton's second law, this approach is limited to presenting the formula ($F=m \cdot a$), explaining the quantities, and solving calculation problems. As a result, students often do not fully understand the relationship between force, mass, and acceleration, accepting the law only as a tool for practical calculations.

In the traditional approach, the second law of Newton is presented in the form of a clear formula:

$$\mathbf{F = ma}$$

where: F — net force, m — mass of the object, a — acceleration of the object.

During lessons, students memorize the formula and learn to calculate force, mass, or acceleration based on given values. For example, if a 5 kg object is acted upon by a 20 N force, students calculate its acceleration.

Typically, lessons are organized as follows:

1. Presentation of the formula.
2. Solving a few example problems.
3. Assigning independent exercises to students.

Advantages: Students learn to perform accurate calculations and develop mathematical skills.

Disadvantages: Students may not deeply understand the law, struggle to analyze phenomena, and have difficulty applying knowledge to new situations. The formulas are considered merely as tools for calculation.

Critical Thinking Approach

In the critical thinking approach, the teaching process encourages active student participation, problem-solving, and analysis. The lesson is typically conducted as follows:

1. Starting with a problem:

For example: "Why does a lighter object move faster than a heavier one when acted upon by the same force?" Students propose hypotheses and discuss them.

2. Experimentation and observation:

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Using real-life examples (cart, ball, car) or simple laboratory experiments, students observe the relationship between force, mass, and acceleration. Students draw conclusions from their observations.

3. Drawing conclusions and explaining the formula:

Based on observations, the formula is introduced as a logical conclusion rather than a memorized rule. Students understand the physical meaning of the formula and learn to apply it in new situations.

Advantages:

Students learn to identify cause–effect relationships;

develop independent thinking and analytical skills;

and can use formulas not only for calculations but also to explain phenomena.

Teaching Newton’s second law using a critical thinking approach enables students not only to perform mathematical calculations but also to deeply understand phenomena, think independently, and analyze situations. Compared to the traditional approach, the critical approach more effectively develops students’ understanding of physics and enhances the teaching methodology of the subject.

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