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ACTIVATING CADETS' INTUITIVE THINKING THROUGH MATHEMATICAL MODELING

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Abstract
This article examines the role of mathematical modeling in developing intuitive thinking among cadets in higher military education. The study analyzes how intuition and analytical reasoning interact during the process of constructing and solving real military problems. Using practical examples — artillery targeting, optimization of logistics, and probabilistic decision models — the paper demonstrates how mathematical modeling enhances cadets' independent thinking, creativity, and the ability to make strategic decisions in uncertain environments.

Keywords: Mathematical modeling, intuitive thinking, military education, probability theory, differential equations, logistics model.

Introduction

Modern military education is evolving in line with technological progress, digital transformation, and the need for analytical thinking. A cadet's success in military operations depends not only on knowledge but also on the ability to analyze complex situations and make rapid, intuitive decisions. **Intuitive thinking** is the capability to synthesize experience and knowledge into an immediate, accurate judgment.

Mathematical modeling serves as an effective pedagogical tool for cultivating such intuition. When cadets build and analyze mathematical models of real military processes, they transform abstract understanding into logical structures, developing both intuition and analytical reasoning in harmony.

1. The Relationship Between Mathematical Modeling and Intuitive Thinking

Intuition is not mere guessing; it is the rapid activation of previously learned logical structures. For instance, during an artillery engagement, an officer cannot

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manually compute all ballistic parameters in real time. Instead, experience allows him to intuitively choose an optimal firing angle. However, when such intuition is reinforced with mathematical understanding - equations of motion, gravitational effects, and wind dynamics - it becomes analytically guided intuition.

The basic projectile motion model is expressed as:

$$y = x\text{tg}\alpha - \frac{gx^2}{2v_0^2\cos^2\alpha}$$

This formula describes the trajectory of an artillery shell. By simulating this model, cadets intuitively perceive how the firing angle α and initial velocity v_0 affect target accuracy - thus strengthening their mathematical intuition through experience-based modeling.

2. Real Military Examples for Developing Intuitive Thinking

2.1. Probabilistic Modeling in Artillery Fire

When studying the probability of an artillery shell hitting the target, cadets use the normal probability distribution model:

$$P = \int_{-R}^{R} f(x)dx = \int_{-R}^{R} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{x^2}{2\sigma^2}}dx$$

Through this model, cadets:

visualize the dispersion of projectiles;

understand the concept of probability density function;

estimate target hit likelihood intuitively based on the shape of the curve.

Thus, theoretical knowledge and real combat sense converge - analytical reasoning enhances intuitive decision-making.

2.2. Logistics Optimization as an Intuitive Model

Consider the task of planning the movement of a tank convoy:

$$\text{Minimize} T = \sum_{i=1}^{n} \frac{L_i}{v_i} + \lambda \sum_{i=1}^{n} F_i$$

where L_i is the road length, v_i is the speed, and F_i is the fuel consumption on segment i.

Cadets use this model to choose the safest and most efficient route, balancing time and fuel constraints.

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During this process, they develop intuitive optimization skills - learning to make sound decisions even with incomplete data.

3. Fostering Strategic Thinking Through Modeling

For military leaders, a mathematical model is more than a calculation tool; it is a **strategic visualization instrument**.

Different mathematical fields play complementary roles:

Probability theory - assessing the reliability of intelligence data;

Differential equations — modeling drone or missile trajectories;

Optimization theory — allocating limited military resources effectively.

When integrated, these fields generate what may be called *scientific intuition* — the ability to foresee system behavior based on analytical insight.

4. Pedagogical Application of Modeling Technologies

To activate intuitive thinking, military education can integrate the following technologies:

1. **MATLAB, Python, or Simulink** simulations for realistic combat scenarios;
2. **Graphical visualization** to connect abstract mathematical results with sensory perception;
3. **Collaborative modeling exercises** for group decision-making;
4. **Statistical analysis** to strengthen probabilistic intuition and adaptability.

For example, cadets simulate artillery trajectories under varying wind speeds and firing angles in MATLAB. This practice allows them to *feel* how mathematical parameters influence the outcome — bridging theory and intuition.

5. Findings and Recommendations

The study demonstrates that:

Mathematical modeling synchronizes intuitive and analytical thinking in cadets;

Translating military problems into mathematical form enhances **creative logical reasoning**;

Simulation-based training develops **analytical sensitivity** and decision accuracy.

Recommendations:

1. Introduce a dedicated course on **“Fundamentals of Military Modeling”** in military academies.

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2. Design laboratory assignments based on **real military examples**.
3. Develop **assessment criteria** for measuring intuitive thinking growth among cadets.

Conclusion

Mathematical modeling trains cadets not merely to compute, but to **perceive, anticipate, and decide**. Intuitive thinking is the invisible weapon of the modern officer — one that unites intellect, logic, and rapid situational awareness. Strengthening it through mathematical modeling is essential for forming competent, adaptive, and strategically minded military professionals.

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