ADVANTAGES OF TEACHING MATHEMATICAL ANALYSIS THROUGH THE THEORY OF ELEMENTARY FUNCTIONS

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Abstract. *This research substantiates a new didactic approach to teaching differential and integral calculus in secondary schools by focusing exclusively on the theory of elementary functions. The approach assumes the continuity of elementary functions as an intuitive fact and integrates this assumption into the process of learning limits, derivatives, and integrals. The method eliminates redundant theoretical barriers, reduces abstraction, and establishes a logical transition from school-level mathematics to higher education. It is a practical realization of Academician A.N. Kolmogorov's idea that the theory of continuous functions should be taught at school, while the general theory of functions should be studied in universities.*

Keywords: *Elementary functions, didactic axiom, continuity, Heine's definition, pedagogical approach, Kolmogorov's idea, mathematical analysis, methodology of teaching mathematics.*

Rationale and Theoretical Framework

Traditional methods of teaching mathematical analysis often overwhelm students with complex definitions and abstract reasoning that exceed the cognitive capabilities expected at the school level.

Concepts such as the limit and continuity of a function are typically introduced using rigorous definitions like those of Cauchy or Heine, which are difficult to comprehend without advanced preparation.

The proposed method simplifies this process by accepting the **continuity of elementary functions as a didactic axiom**. Since graphs of elementary functions — polynomials, trigonometric, exponential, and logarithmic — are visually continuous lines, students can intuitively perceive them as continuous within their domains. From this starting point, the concept of a limit can be reintroduced as a property of continuous functions, thereby creating a smooth conceptual pathway toward the study of derivatives and integrals.

Methodological Significance

Within this framework, the phrase "for any sequence approaching a point" in Heine's definition of a limit is replaced with "for some sequence approaching a point." This modification is justified for continuous functions and allows students to develop an understanding of limits without being burdened by unnecessary generality. It also nurtures analytical reasoning, as learners are encouraged to think about functions in terms of visual continuity and sequential behavior.

Moreover, this structure encourages logical progression: students first explore the intuitive concept of a continuous line, then examine the limit of continuous functions, followed by differentiation and integration. Each step builds naturally on the previous one, providing a coherent learning trajectory that strengthens comprehension and minimizes rote memorization.

Results and Educational Impact

Applying this approach in the classroom leads to several benefits:

1. **Conceptual clarity** — Students understand that continuity underlies all processes in calculus.
2. **Reduced cognitive load** — Theoretical definitions are introduced gradually, with intuitive examples preceding formal proofs.
3. **Creative engagement** — Learners are motivated to visualize mathematical relationships and apply them in problem-solving.
4. **Smooth transition to higher education** — When encountering the general theory of functions later, students already possess a conceptual framework grounded in continuity.

The proposed order of topics — *limit of a sequence* → *limit of a continuous function* → *derivative* → *integral* — contrasts with the traditional structure and provides pedagogical coherence.

Conclusion

Teaching mathematical analysis through the theory of elementary functions not only aligns with the historical and logical development of mathematics but also fulfills modern educational needs for clarity and accessibility. By incorporating the continuity axiom into the teaching process, mathematics becomes more intuitive, engaging, and effective for secondary school students. This approach bridges the theoretical gap between school and university curricula and cultivates students' creative and logical thinking, contributing to the training of highly qualified specialists in the future.

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