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USING CASES IN MATHEMATICAL ANALYSIS

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Abstract
This article discusses the effectiveness of using the case method in teaching mathematical analysis in the higher education system. Compared to traditional teaching methods, teaching based on cases allows students to develop independent thinking skills, form the ability to apply theoretical knowledge in practice, and strengthen critical thinking competencies in analyzing and solving problem situations. The article analyzes in detail the stages of selecting, compiling cases, and integrating them into the teaching process. Also, based on the results of research conducted in the experimental group, the positive results of the case method in the educational process are substantiated. In the conclusion, practical recommendations are given for expanding the use of case technologies in mathematical analysis.

Keywords: Mathematical analysis, case method, case technology, interactive learning, practical problem, student activity, critical thinking, independent learning, innovative approach, lesson effectiveness.

Introduction

The plan of work to be carried out on each problem or topic studied by the case study method, the details of their implementation, the results and conclusions form a separate case. This method is aimed at using real-life situations in the educational process. This is one of the current problems in the field of education. The fact that this method allows solving this problem shows that it is of particular importance.

Therefore, in educational institutions in Western countries, the use of the case study method, that is, cases, makes up 25% of the curriculum. In this regard, we will briefly touch on the importance of using real-life situations in educational

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institutions. The use of the case study educational method in the study of various cases is an educational process aimed at organizing the study of typical situations taken from life or requiring students to find appropriate solutions to relevant problems based on artificially created situations. This method allows learners to model practical activities to diagnose a life situation related to the topic, formulate hypotheses, identify problems, collect additional information, clarify hypotheses, and design specific stages of problem solving and implementation.

The use of cases dedicated to specific life situations connects the educational process with real life. When considering a case, students create a learning process. In this process, their interaction occurs, real situations of exchange of ideas arise. Cases give students the freedom to analyze, search for ways to compare and solve problems. The use of cases is also of great importance in mathematics lessons. The role of cases in the educational process is multifaceted, and they include the following functions:

1. Serves for a deeper understanding of mathematical concepts and the connections between them.
2. Ensures the mastery of special concepts included in the subject of the problem.
3. Serves for a deeper understanding of the connections between functional ideas.
4. Develops students' abilities to analyze, solve, and justify.
5. Develops the ability to think logically.
6. It comprehensively shapes the personality, requires self-control.
7. It increases students' interest in mathematics.
8. It guides students in choosing a profession and increases their professional training.
9. It tries to understand the quantitative relationships between various life facts.

We give examples of cases that occur in the science of mathematical analysis.

Cases.

1. 1. What is the problem of calculating the limit of the function

$\lim_{x\to\infty} \frac{(ax+1)^n}{x^n+A}$? What are the reasons for the diversity of answers?

Asosiy muammo:

The main problem:

Try to answer the following questions.

Does the result of the limit depend on a,A and n?

What is the solution if n < 0?

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What is the solution if n > 0?
What is the solution if n = 0?
Determine what the main problem is aimed at. Extract the main content of the problem. Analyze the problem situation - determine the state of the object, pay attention to its main features, analyze all aspects of the problem situation?
Solution.

1) $n > 0$ if, $\lim\limits_{x\to\infty} \frac{(ax+1)^n}{x^n+A} = a^n$

2) $n < 0$ if $\lim\limits_{x\to\infty} \frac{(ax+1)^n}{x^n+A} = \begin{cases} 0, \text{if } A \neq 0 \text{ if,} \\ a^n \text{ if } A = 0; a \neq 0 \text{ if,} \\ \infty, \text{if } a = 0 \text{ if.} \end{cases}$

3) $n = 0$ if, $\lim\limits_{x\to\infty} \frac{(ax+1)^n}{x^n+A} = \frac{1}{1+A}$

2. What is the problem of solving the integral $\int \frac{dx}{x^2+px+q}$? What are the reasons for the different answers?
Main problem:
Try to answer the following questions.
Does integration depend on the denominator of the expression under the integral?
a) What is the solution if D < 0?
b) What is the solution if D > 0?
c) What is the solution if D=0?
Solution.
a) If the quadratic equation $x^2 + px + q$ has $D < 0$, that is, $p^2 - 4q < 0$ then the solution to the given integral is in the form of an inverse trigonometric function..

$$\int \frac{dx}{x^2 + px + q} = \int \frac{dx}{(x + \frac{p}{2})^2 + q - \frac{p^2}{4}}$$

$(x + \frac{p}{2})^2 + q - \frac{p^2}{4}$ kIn order for $D < 0$ in the quadratic equation $q - \frac{p^2}{4} > 0$ must.

$$\int \frac{dx}{x^2+px+q} = \int \frac{dx}{(x+\frac{p}{2})^2+q-\frac{p^2}{4}} = \frac{2}{\sqrt{4q-p^2}} \text{arctg} \frac{2x+p}{\sqrt{4q-p^2}} + C$$

b) then the solution of the given integral is in the form of a logarithmic function $x^2 + px + q$, $D > 0$, ya'ni $p^2 - 4q > 0$

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$$\int \frac{dx}{x^2+px+q} = \int \frac{dx}{(x+\frac{p-\sqrt{p^2-4q}}{2})(x+\frac{p+\sqrt{p^2-4q}}{2})} = \frac{1}{\sqrt{p^2-4q}} \ln\left|\frac{2x+p-\sqrt{p^2-4q}}{2x+p+\sqrt{p^2-4q}}\right| + C$$

v) If $D = 0$ of the quadratic equation $x^2 + px + q$, $p^2 - 4q = 0$ then the solution of the given integral is in the form of a power function.

$$\int \frac{dx}{x^2+px+q} = \int \frac{dx}{(x+\frac{p}{2})^2} = \frac{-1}{(x+\frac{p}{2})} + C$$

$$\text{Answer:} \begin{cases} \text{if } D < 0 \text{ if,} \frac{2}{\sqrt{4q-p^2}} \operatorname{arctg} \frac{2x+p}{\sqrt{4q-p^2}} + C \\ \text{if } D > 0 \text{ if,} \frac{1}{\sqrt{p^2-4q}} \ln\left|\frac{2x+p-\sqrt{p^2-4q}}{2x+p+\sqrt{p^2-4q}}\right| + C \\ \text{if } D = 0 \text{ if,} \frac{-1}{(x+\frac{p}{2})} + C \end{cases}$$

2. Does the solution of the integral $\int \frac{dx}{x^2+A}$ $(A \in Z)$ depend on the values that A takes on the set Z? How many steps does the process of solving the integral take? What are the functions in which the integral solution is expressed?

Solution.

The solution depends on the values that A takes on in the set Z.

In this case, there may be cases A<0,A=0,A>0. So, the integration process proceeds in 3 stages..

a) If $A < 0$ if, $\int \frac{dx}{x^2+A} = \frac{1}{2\sqrt{A}} \ln\left|\frac{x-\sqrt{A}}{x+\sqrt{A}}\right| + C$

b) If $A = 0$ if, $\int \frac{dx}{x^2+A} = \frac{-1}{x} + C$

v) If $A > 0$ if, $\int \frac{dx}{x^2+A} = \frac{1}{\sqrt{A}} \operatorname{arctg} \frac{x}{\sqrt{A}} + C$

$$\text{Answer:} \begin{cases} \text{if } A < 0 \text{ if,} \frac{1}{2\sqrt{A}} \ln\left|\frac{x-\sqrt{A}}{x+\sqrt{A}}\right| + C \\ \text{if } A = 0 \text{ if,} \frac{-1}{x} + C \\ \text{if } A > 0 \text{ if,} \frac{1}{\sqrt{A}} \operatorname{arctg} \frac{x}{\sqrt{A}} + C \end{cases}$$

Many similar examples can be given. We can conclude from these examples that every parametric example and problem in mathematics can be considered a case..

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