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Analysis Of Student Errors In Definite Integration Solutions

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Abstract: The aim of the present study is to investigate mathematical mistakes related to definite integration committed by Yashwantrao Chavan Polytechnic students at First Year Diploma Level in their academic. For this study 69 students from first year diploma classes were chosen randomly. The samples of this study were collected from the test attempted by the participants. The following are the primary difficulties that students face while solving definite integration problems; didn't get the basics, had trouble choosing how to solve, relied on memory, didn't do enough practice, time was a problem.

KEYWORDS: Definite Integration problems, Problem-Solving, Conceptual Understanding, Time Management.

I. INTRODUCTION

Definite integration is a fundamental concept in calculus, used to find the accumulation of quantities over a specific interval. It is closely related to the concept of finding areas under curves, but it has applications far beyond just geometry. And it plays a vital role in a wide variety of applications, both in mathematics and in real-world problems. Definite integration problems, though challenging, are a fundamental component of the curriculum for students studying math and science. Many students, however, struggle when it comes to solving these problems. This research paper will investigate the typical difficulties students encounter with definite integration and the strategies that can aid them in overcoming these obstacles.

II. OBJECTIVES OF THE STUDY

This study examines the mathematical errors made by first-year diploma students while solving problems. It also investigates the underlying reasons for these mistakes. The study aims to:

a) Focus on enhancing conceptual understanding.
b) Emphasize effective problem-solving strategies.
c) Incorporate the use of mnemonics and memory aids.
d) Provide sufficient practice opportunities.
e) Promote effective time management.

III. SIGNIFICANCE OF THE STUDY

The importance of this study will be highly beneficial for mathematics teachers, encouraging them to dedicate more time to teaching fundamental concepts, as well as providing greater focus and sufficient time for solving mathematical problems.

IV. RESEARCH QUESTIONS

1. What difficulties do students at Yashwantrao Chavan Polytechnic face while solving definite integration problems in applied mathematics at the First Year Diploma level?
2. What are the reasons behind the difficulties students face while solving problems related to definite integration?

V. METHODS, SAMPLES AND PROCEDURES

(A) SUBJECTS

The current study involves 69 students pursuing their First Year Diploma at Yashwantrao Chavan Polytechnic. These participants are enrolled in various engineering streams, namely Civil Engineering, Computer Science and Engineering, Electrical Engineering, Electronics and Telecommunication Engineering, and Mechanical Engineering. Each student attends 4 hours of lectures and 2 hours of tutorials weekly. Their ages range between 17 and 18 years, and they have been studying mathematical concepts for the past ten years. The sample specifically targets students from the aforementioned engineering disciplines.

(B) INSTRUMENTS

In order to collect reliable and authentic data, the following instruments were employed in this study.

(C) STUDENTS' TEST

To address the initial research question—what challenges do First Year Diploma students face when solving definite integration problems in Applied Mathematics—the researcher designed a test worth 20 marks. This assessment included mathematical problems focused on integration, covering categories such as basic algebraic rational functions, substitution techniques, and the method of integration by parts. The following procedure was implemented to conduct the study.

1. Collected a sample of student work for each type of Definite Integration problem related to simple algebraic rational function, definite integration by substitution method, definite integration by-part.
2. Recorded all student responses in written format.
3. Analyzed the responses and looked for patterns among common problem types.
4. Described the patterns observed in simple language and the possible reasons for the Student's problems

Table 1 outlines the challenges encountered in solving definite integration problems in Applied Mathematics, along with their potential underlying causes.

Example	Mistakes	Description Possible cause
Simple algebraic rational function Evaluate $\int_2^5 \frac{1}{(x-5)}\,dx$	1.Incorrect application of integration rules 2.Forgetting the constant of integration	1. Students might incorrectly apply definite integration techniques such as the power rule, substitution method, or integration by parts, which often results in inaccurate solutions. 2. In Definite Integration, students occasionally overlook the inclusion of the constant of integration (C), which is essential as it represents the family of possible anti derivatives for a given function.
Substitution method Evaluate $\int_0^{\frac{\pi}{2}} e^{\sin x}.\cos x\,dx.$	1.Algebraic errors	1. During the integration process, students might make algebraic errors when simplifying expressions or manipulating equations. These

	2.Misunderstanding the problem	mistakes can carry through the solution, leading to incorrect final answers. 2. At times, students may misinterpret the problem statement or misunderstand the core concepts, which can cause them to apply an incorrect integration method or formula, ultimately leading to wrong solutions.
Integration by-part Evaluate $\int_0^1 x\, e^x\, dx$	1.Not checking their work 2.Incorrect application of integration rules	1. Students might overlook the importance of verifying their final answers or performing back-substitution to ensure their solution fits the original problem. Such oversights can allow errors to go unnoticed. 2. Students might incorrectly apply integration rules like the power rule, substitution, or integration by parts, which can result in inaccurate solutions.

Table No: 1

VI. RESULTS AND DISCUSSION

The researcher analyzed the written responses submitted by the students, and the findings revealed that the most common mathematical errors fell into the following categories: simple algebraic rational functions and integration by parts. A total of 86 mathematical mistakes were identified. Table 2 below presents these errors by number and percentage:

Mistakes Category	Number of Mistakes	Percentage of Mistakes
Simple algebraic rational function	28	32.55 %
Substitution method	19	22.09%
Integration by-part	39	45.34%
Total	**86**	**100 %**

Table No: 2

Table 2 classification of the type of errors generated in the context of the study

- **Simple algebraic rational function**

There were 28 basic errors related to simple algebraic rational functions, accounting for 32.55% of the total mistakes identified during the data analysis. These errors are further categorized into subgroups, as shown in Table 3 below:

Type of Mathematical mistake	Number
Incorrect application of integration rules	16
Forgetting the upper & lower limit	12

Table No: 3

- **Substitution method*:***

There were 19 fundamental errors related to the substitution method, representing 22.09% of the total mistakes identified in the data analysis. These errors are further broken down into subcategories, as shown in Table 4 below:

Type of Mathematical mistake	Number
Algebraic errors	10
Misunderstanding the problem	9

Table 4

❖ **Integration by-part**

There were 39 fundamental errors related to integration by parts, accounting for 45.34% of the total mistakes identified during the data analysis. These errors are further classified into subcategories, as presented in Table 5 below:

Type of Mathematical mistake	Number
Not checking their work	23
Incorrect application of integration rules	16

Table 5

VII. CONCLUSION

Definite integration is a fundamental concept in calculus, yet many students encounter challenges when solving related problems. These challenges often stem from limited conceptual understanding, difficulty in selecting appropriate techniques, overreliance on memorization, insufficient practice, and poor time management. Educators can help overcome these obstacles by emphasizing deep conceptual learning, teaching effective problem-solving strategies, incorporating memory aids, offering regular practice opportunities, and promoting time management skills. By tackling these issues, students can build the competence and confidence needed to approach integration problems successfully.

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