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The Evolution of Anti derivatives Teaching Techniques: From Traditional to Technology-Based Instructions

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Abstract
Human civilization has historically been based on education, which is directly related to a country's future growth. The focus of contemporary teaching approaches is on developing students' opinions and abilities in an informal, student-centered classroom setting that uses technology more and more. Children's everyday activities frequently incorporate interactive technologies, which encourage creativity and participation and are crucial to modern education. This study examines how well eleventh-grade math students learn anti derivatives using traditional and technology-based approaches. Data were gathered quantitatively using surveys and pre- and post-tests from different educational institutions. The results show that whereas traditional approaches improve student comprehension to some extent, technology-based approaches greatly improve learning outcomes and retention, closing the achievement gap between students.
The study emphasizes how crucial it is to include technology into teaching methods in order to create a more equitable and productive learning environment, especially teaching anti derivatives in Mathematics. To improve educational effectiveness, which is suggestions are made for further research and for modifying teaching methods by incorporating technology-based techniques.

Keywords: *Traditional Methods, Modern Technology, Anti derivatives*

I. Introduction

Education has always become one of the most important sectors of human civilization since ancient times, because the development of any country's educational system is closely related to its future development. Education has always become one of the most important sectors of human civilization since ancient times, because the development of any country's educational system is closely related to its future development.

Modern teaching methods pay more attention to improving students' values and abilities. In the modern classroom, the teaching atmosphere is more relaxed, and there are multiple technology products to assist teaching and the classrooms are student-centered. Mainly multiple teaching products consist of electronic devices.

Nowadays, interactive technology is more and more embedded in children's daily activities ((Markopoulos, Read, & Höysniemi, 2008). Children make the use of these interactive products such as games, toys or educational applications. They use them either in schools or in homes and in outside them. These technological products have in common that they are mainly designed to help interaction, encourage, motivate to the social activities and enhance creativity (Pitt, 2006). As a logical consequence of this era's digitally rich culture, children get in contact with interactive technology more often during their learning activities in school and colleges (Good, 2010).

Technology indicates that there is communication between the user and the technological system and possible interaction with technological systems relies on the ability of the system to demonstrate interactive behavior (Dix, Finaly, & Beale, 2004). According to (Reiser, 2011), technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning. In the research of (Kadaruddin, 2017) that the use of computer is essential in teaching to improve outcomes and motivation of learners and improved learning outcomes and motivation of learners are direct indicators of effectiveness and efficiency of the learning however computer based learning also has drawbacks. In the report of (Hendriks, 2016), it was found that children hold more positive attitudes towards the tablet-based learning method than towards the traditional learning method. The finding of (Wang Y. , 2022) is that the modern teaching method can better cultivate the talents of students, can be used in special education, and so on. Digital

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pedagogical skills are crucial for teachers in blended learning, artificial learning, communication, collaboration, evaluation, and problem-solving, with competency frameworks incorporating academic and professional development components (Linneweber-Lammerskitten, 2012).

The traditional teaching method is teacher-centered teaching method to instruct book knowledge to students. In the traditional classroom, students must obey discipline to ensure a good learning environment and teachers are the controllers of the class which insures the achievement of the student finally.

The general approach of a mathematician is to try to simplify a complex mathematical topic, by breaking it up in smaller parts that can be ordered in a sequence that is logical from a mathematical point of view (Gravemeiger & Doorman, 1999).To accommodate changing student demographics in mathematics classrooms, a culturally relevant pedagogy theory is needed. This approach connects students' culture with school subject matter, integrating a culturally relevant curriculum into existing curriculums. Teachers should contextualize learning by relating content to students' culture and real-life experiences(Rosa & Orey, 2011). Students bring mathematics from home, and teachers must integrate it into their classrooms. To ensure cultural congruence, teachers should respect and understand students' cultural traditions and languages. Traditional teacher-centered teaching methods often lack student involvement, hindering curriculum objectives. Motivation is crucial for arousing curiosity and making the classroom interactive. A good teacher should follow students' interests, foster knowledge, and be knowledgeable about teaching methods, technology, learning theories, and materials. They should also prepare mathematical teaching materials and models(Rosa & Orey, 2011).

The utility of calculus in higher school teaching emphasizes its integration and practical application in real-life problems. Mathematics should be associated with real-life problems, not just the solution itself. Teachers often make mathematics complex, focusing on connecting real-life problems with mathematical language and problems rather than presenting stories involving mathematics problems. Although he did not elaborate on its uses in other domains, (Howard, 1983)investigated integration as a technique for determining area, volume, and arc length. According to (Tall, 1997)mastering calculus equips pupils to handle challenging algebra and arithmetic by laying the groundwork for more difficult mathematics. Student involvement is greatly impacted by the teaching strategies used, with technology being a key component. (Cheshier, 2006)demonstrated the importance of mathematical abilities in science and engineering by finding that mastery of calculus is necessary for success in these domains.

II. Objectives of the Study

Research on teaching antiderivatives reveals gaps in comparing traditional and technology-based methods. While technology can improve student engagement, there's limited research on its effectiveness in teaching this concept. Further studies should explore its impact on long-term retention, problem-solving skills, and critical thinking abilities, and the impact of teacher expertise. So, the researchers have the aim To compare and contrast the achievements of the students studying from the traditional way of learning and using the technology in learning anti derivatives.

III. Hypothesis

On the basis of the research objective, researcher purposed the hypothesis that is given as:

H_0: There is no significant difference between the achievements of the students studying from the traditional way of learning and using the technology in learning anti derivatives.

H_1: There is a significant difference between the achievements of the students studying from the traditional way of learning and using the technology in learning anti derivatives.

IV. Methodology

This study looks at how teaching anti derivatives to eleventh-grade students in basic and business mathematics is affected by technology versus conventional approaches. It took a quantitative method, evaluating comprehension with both pre- and post-tests. Surveys with both open-ended and closed-ended questions were used to collect data from different universities and colleges that provide programs in engineering, science, education, the humanities, and business. Purposive sampling was used to choose schools and campuses like Shree Adhunik Rashtriya Secondary School, Shree Bhutan Devi Secondary School, Hetauda Campus and Makawanpur Multiple Campus, for the sample, while random sampling was used to find representative students for generalization. A 99% confidence level was used to determine a sample size of 400 pupils. The questionnaires were improved through expert feedback and pilot testing to ensure tool validity. The study included both

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primary and secondary sources, with the main data coming from organized surveys focused at students. A control group and an experimental group were established, with the former receiving instruction through conventional means and the latter through the use of technology. Each group attended a two-hour instructional session delivered by the researcher, and learning outcomes were evaluated by pre- and post-tests. In addition to enhanced approaches like ANOVA tests, the statistical analysis included descriptive methods like frequency tables and estimations of means and standard deviations. The findings and subsequent discussion highlighted variables that influence differences in student learning outcomes and provided insightful information about the efficacy of computer-assisted learning in comparison to standard approaches.

V. Result and Discussion

Comparison of Traditional and Technology based methods

Student results on anti derivatives clearly differ between traditional and technology-based teaching approaches. Although there were significant differences in student performance, traditional teaching resulted in a modest gain in average scores from the pre- to post-test, indicating some learning progress. This implies that although traditional approaches were beneficial, they were not always as effective in providing equal support to all pupils. On the other hand, more consistent student performance and a greater increase in average scores were the results of technology-based instruction. Higher scores and less variation were found in post-test results, suggesting that technology-based approaches not only enhanced general comprehension but also assisted in bridging the achievement gap amongst students. This implies that for complicated subjects like anti derivatives, technology-enhanced training offers a more efficient and appropriate learning environment.

Table: 1

Comparison of Traditional and Technology based methods on Students' outcomes

Methods	Pre Test			Post Test		
	Number	Average Score		Number	Average Score	
		Obtained Marks	%		Obtained Marks	%
Traditional Method	200	4.48	28.03	200	6.975	43.59
Technology Based Methods	200	4.21	26.31	200	11.07	69.19

Source: (The Survey data, 2023)

The study compares traditional and computer-based approaches for teaching anti derivatives. Traditional methods showed a moderate improvement in student knowledge, with an average score of 28.03%. However, there was still a significant disparity in topic expertise. Technology-based methods showed a more significant improvement, with an average score of 69.19%, indicating their potential for providing a more engaging educational experience. Both methods showed improvement in student performance, highlighting the potential of technology in teaching complex subjects. It can be presented below:

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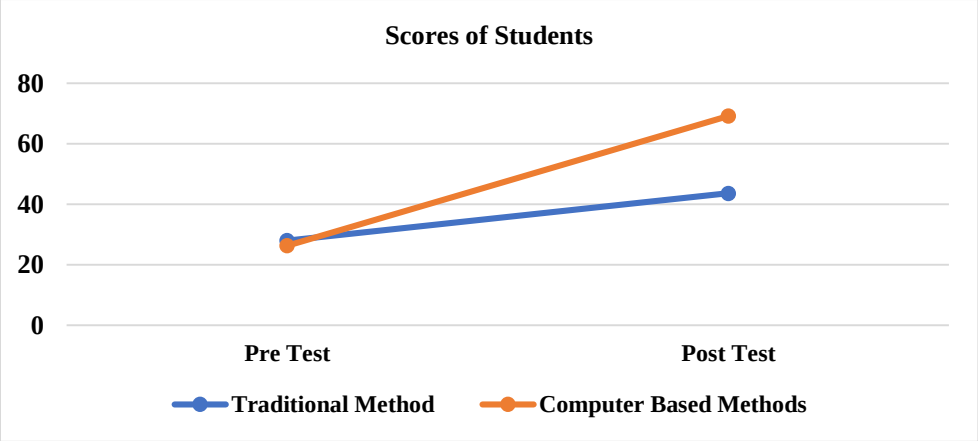
Figure 1

The scores of students on Anti derivatives



Source: (The Survey data, 2023)

Significant difference of Pre-Test between Traditional and Technology based Methods

The study found a significant difference in pre-test scores between traditional and technology-based students, with technology-based students showing slightly higher baseline understanding. This suggests that interactive technology may attract students familiar with digital tools, but raises questions about readiness and engagement levels in traditional settings.

Table 2

Significant difference of Pre-Test between Traditional and Technology based Methods

Pre tests	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Trad. & Tech. Methods	.275	3.068	.2167	-.1529	.7029	1.27	199	.207

Data Source: (The Survey, 2023)

The results of a paired samples t-test comparing pre-test scores for conventional and technology-based approaches are displayed in the table. With a standard deviation of 3.068 and a standard error of 0.2167, the average score difference is 0.275. This difference is not statistically significant, as indicated by its 95% Confidence Interval, which spans from -0.1529 to 0.7029, including zero. With 199 degrees of freedom, the t-value is 1.27 and the p-value is 0.207, both of which are over the conventional cutoff point of 0.05. This implies that pre-test results from traditional and technology-based methods are comparable, suggesting that both strategies adequately prepare students for upcoming education.

Significant difference of Post Test between Traditional and Technology based Methods

The study reveals that students who learned through technology-based methods performed better on post-tests, indicating that integrating technology into teaching can improve understanding and retention, thus emphasizing the need for effective teaching strategies.

Table 3

Significant difference of Post Test between Traditional and Technology based Methods

Pre tests	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error	95% Interval	Confidence of the			

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			Mean	Difference				
				Lower	Upper			
Trad. & Tech. Methods	4.095	8.081	.5714	2.968	5.222	7.17	199	.000

Data Source: (The Survey, 2023)

A paired samples t-test comparing post-test scores for technology-based and traditional techniques is shown in the table. The average score difference of 4.095 indicates that technology-based approaches outperformed conventional approaches in terms of post-test outcomes. The discrepancies have a standard deviation of 8.081 and a standard error of 0.5714. There is a considerable difference between the two approaches, as indicated by the 95% CI for the difference, which is 2.968 to 5.222 and excludes zero. With 199 degrees of freedom, the t-value is 7.17 and the p-value is 0.000, both of which are below the typical alpha criterion of 0.05. This suggests a result that is statistically significant.

VI. Discussion

This study, like the (Atuahene, Xu, & Bentum-Micah, 2024)study, found that digital learning materials such as e-textbooks can improve learning outcomes in mathematics for younger students. It also highlights that technology-based methods can be particularly effective for complex mathematical topics such as calculus. Both findings demonstrate that when technology is used effectively in specific learning areas, it can improve student knowledge and performance.(Wang Y. , 2022)findings, as well as the anti derivatives study, highlight the fact that modern and technology-based procedures can better foster skills or understanding than traditional ways. In the case of anti derivatives, a complicated mathematical topic, technology aids may help break down difficult concepts, just as modern approaches in Wang's study aim to reflect a wider variety of educational needs and growth in skills.

(Petruse, Grecu, Gakić, Gutierrez, & Mara, 2024) demonstrated the benefits of realistic environments in improving learning results and reducing cognitive burden. Similarly, this study's technology-based teaching methods may assist students in grasping abstract calculus topics anti derivatives by engaging with them visually and interactively, reducing cognitive load when compared to traditional methods.

(Ganitano, Mejia, & Quiazon, 2019)discovered that traditional learning approaches outperformed technology-based ones for Grade 10 mathematics pupils. This is in contrast to this study, which revealed that technology-based methods were more beneficial for senior secondary pupils in calculus. This disparity implies that the usefulness of technology may vary based on the kids' grade level, subject difficulty, and type of content given.(Martirosov, et al., 2023)discovered that, while students favored traditional approaches, they performed well with unconventional resources. In contrast, this study focused on performance rather than preferences, finding that technology-based strategies were superior for understanding anti derivatives. This contrast demonstrates that performance advantages do not always coincide with student preferences, implying that choice is not always a good predictor of effective learning.

In their analysis of how people view traditional and innovative educational systems, (Cadis, Point, Ticau, & Vavura, 2023)pointed out that whereas traditional education encourages uniformity, alternative approaches foster innovation and adaptation. Although the anti derivatives study supports the idea that technology can provide flexibility in the study of complex subjects, it does not necessarily complain about the methodical approach of traditional methods; rather, it raises the possibility that technology could provide a supplementary advantage for specific academic problems, such as anti derivatives.

Thus, the study supports research showing that technology can be especially useful for certain learning objectives and in particular subject areas, as demonstrated by studies such as (Atuahene, Xu, & Bentum-Micah, 2024)and (Petruse, Grecu, Gakić, Gutierrez, & Mara, 2024). It differs with (Ganitano, Mejia, & Quiazon, 2019)whose research backed traditional techniques in mathematics and suggested that student level, subject difficulty, and educational situation may all affect how effective a method is. These results ultimately imply that although technology-based approaches might be useful, particularly for difficult subjects like calculus, their overall effectiveness may vary depending on the situation.

VII. Conclusion

This study clearly shows that when it comes to teaching complicated subjects like anti derivatives, technology-based teaching strategies

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offer a significant edge over traditional methods. Although students' knowledge was enhanced by both approaches, traditional training only slightly raised average scores, and student achievements varied greatly. This implies that even while traditional approaches are useful, not all pupils may always benefit equally from them. On the other hand, pupils who used technology-based strategies performed more consistently and had much higher post-test results. These strategies not only enhance general comprehension but also provide a more egalitarian learning environment, as seen by the higher average score rise and smaller performance disparity. The potential of technology-based instruction to improve learning effectiveness and encourage more balanced results among students is highlighted by the statistically significant difference in post-test scores, which was validated by a t-test.

Having been considered, these results imply that using technology in the classroom could provide a more inclusive and effective learning environment, especially for teaching anti derivatives where student performance frequently differs greatly. Technology-based instruction can help bridge achievement gaps, reducing performance disparities. Investing in teacher training and resource allocation is crucial for maximizing benefits. Further research is needed to understand the long-term impact of technology on knowledge retention in complex topics. These recommendations aim to create an effective, engaging, and equitable learning environment. Similarly, Authorities are advised to adapt their anti derivatives instruction plans for grades XI and XII to include technology-based techniques. Government-sponsored initiatives that offer specialized training packages should be used to train teachers on contemporary technologies.

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