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UTILIZING DIGITALIZATION IN DIFFERENTIATION: INTEGRATION OF DESMOS IN LEARNING ANALYTIC GEOMETRY AND CALCULUS

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ABSTRACT

The goal of this research is to identify the roles of the Desmos Graphing Calculator in Analytic Geometry and Calculus. The researchers investigated the roles of the Desmos graphing calculator through its features, in the students' perspective and performance, and utilization as a teaching and learning tool. The mastery of the skill is needed on the proceeding topics in Analytic Geometry and Calculus such as point-slope form, slope-intercept form, two-point form, derivatives, and tangent line. This study used a quasi-experimental research design to know the cause-and-effect of the role of using Demos as technology in learning Calculus and Analytic Geometry of third-year mathematics students of Nueva Ecija University of Science and Technology. This study utilized paired t-test for independent samples to test whether there is a significant difference. Results showed that it made enough statistical evidence to have concluded that there is significant difference in the students' perspective before and after using Desmos Graphing Calculator in Analytic Geometry and Calculus. It also showed that there is a significant difference in the students' performance before and after using Desmos Graphing Calculator.

Keywords: Quasi-experimental, Desmos Graphing Calculator, Analytic Geometry and Calculus.

INTRODUCTION

It is 2022, and there is no arguing that the use of technology has been part of people's lives, especially teenagers. People use technology in many ways, such as communication, entertainment, information providers, and many more. Appropriate use of technology can serve the regular education classroom by motivating students in all disciplines, such as math, social studies, and literacy (Liu, 2016; Housand & Housand, 2012). The students of today are surrounded by technology, which makes it easy for them to gather the information that they need.

Modern mathematical applications have kept up with mobile technological advances (Nadel, 2012; Wahl, 2015). For individuals with computers, tablets, phones, and other mobile devices, a variety of calculators, including online graphing calculators and downloaded programs, are accessible for free or a small fee. These online graphing calculators include user interfaces that make manipulating data, equations, and graphs incredibly simple. Further research has been done to determine the impact of technology's ongoing efforts to make arithmetic computations simpler and more intuitive on students' confidence in their ability to solve problems as they apply mathematics in real-world contexts.

One model of an online graphing calculator is the Desmos Calculator. It is downloadable for free for mobile devices or used in its online application. Its developers have included built-in content such as a bank of equations, a dual workspace that includes data and graphs located on the same screen, and application anticipation features such as automatically displaying vital information about the graph (Desmos, 2015). Students can access the graph, table, and key facts about the function of Desmos on one screen.

Desmos is now easier to use and more intuitive in its approach to math thanks to these factors, which reduce the steps that get in the way of the deep thinking needed to solve math problems. Intuitive features benefit high school students because they can easily navigate challenging math concepts with apps found on mobile technology (Freeman, 2012). This website-based tool is highly beneficial for getting children involved in their math lessons. Desmos provides numerous benefits over other graphic design software programs or applications, including being free, simple to use, intuitive, and powerful (Ebert, 2014).

In the mathematics classroom, handheld graphing calculators have reigned for decades. Desmos now provides a completely free app that is not too difficult for teachers and students to learn. Desmos is a game-changer, according to Sara Vanderwerf, who wrote on her blog in 2016: "DESMOS IS A GAME CHANGER. Desmos is an equity and access answer for all our students." In a study by Usher & Center on Education (2012), real-world applications of technology along with other academic subjects help motivate students.

However, according to Chen of the International Journal of Learning, Teaching, and Educational Research (Vol. 2, No. 2, 2015), there is not enough study to prove that using graphing calculators has positive or significant effects on learning mathematics. Because of this observation, the researchers of this study aimed to investigate the role of using Desmos as a technology in the learning of selected concepts of analytical Geometry and Calculus among Third-year Mathematics students at the College of Education of Nueva Ecija University of Science and Technology.

STATEMENT OF THE PROBLEM

The roles of Desmos as technology in students learning Analytic Geometry and Calculus. Specifically, this study aims to answer the following:

How may the features of Desmos be described in terms of:

1.1 actions;

1.2 color appearance; and

1.3 plotting equations?

2. How may the perspective of students in Analytic Geometry and Calculus be described before using Desmos?

3. How may the performance of students in Analytic Geometry and Calculus be described before using Desmos?

4. How may the perspective of students in Analytic Geometry and Calculus be described after using Desmos?

5. How may the performance of students in Analytic Geometry and Calculus be described after using Desmos?

6. Is there a significant difference in the students' perception of Analytic Geometry and Calculus before and after using Desmos?
7. Is there a significant difference in the student's performance in Analytic Geometry and Calculus before and after using Desmos?
8. How may the utilization of Desmos be described in terms of:
8.1 teaching tool; and
8.2. a learning tool?

METHODOLOGY

Research design. In this study, the researchers used a Quasi-experimental research design to investigate the role of using Demos as technology in learning Analytic Geometry and Calculus for third-year mathematics students at Nueva Ecija University of Science and Technology. Since this study wants to know the cause-and-effect relationship of using Desmos in learning Analytic Geometry and Calculus, uses a non-random sampling technique, and will be used for a practical reason, a quasi-experimental design is suitable for this research.
Research Locale. This study was conducted at the College of Education in Nueva Ecija, University of Science and Technology, located at Sumacab Este Cabanatuan City, Nueva Ecija.
The Sample and Sampling technique. In this study, the researcher used purposive sampling. It is a non-probability sampling that is selected based on the characteristics of the population and the objective of the study. The samples for this study were fifteen third-year students from the Nueva Ecija University of Science and Technology who have taken the courses Point Slope Form, Slope Intercept Form, Two-Point Form, Derivatives, and Tangent Line under study. In the selection of the samples, the following criteria were considered:
1. Currently enrolled as a third year BSED major in Mathematics
2. Had taken the topics of Point Slope form, Slope Intercept form, Two-point form, derivatives, and Tangent line under the course SEM 8: Analytic Geometry and Calculus.
3. Obtained a grade between 1.75 to 3.00

RESEARCH INSTRUMENT

TMTC1: Pre-test and Post-test. The pre-test was administered to measure the student's ability before giving treatment. Post-test was the test that was given after treatment to determine what the students had learned. This instrument gave the researchers an idea of the impact of Desmos on the students' performance in analytic geometry and calculus.
Questionnaire. This survey form was used to gather data from the students. The data was collected and contains a description of the students' experiences with the features of Desmos. In addition, it was also used to get the perceptions of the subjects in Analytic Geometry and Calculus before and after using Desmos.
Desmos Graphing Calculator. Desmos encourages students in math to discover and explore equations. It was to teach, solve, and plot the topics under the subject of analytic geometry and calculus, which are point-slope form, slope intercept form, two-point form, derivatives, and tangent lines. It serves as the independent variable in this study.
Statistical Analysis of the Data. This study utilizes experimental research that was intended to investigate the role of using Demos as technology in learning analytic geometry and

calculus. The following statistical techniques were applied to interpret the data collected by the researchers:

1. To describe the features of Desmos, the weighted mean together with its verbal interpretation was utilized, 3.26 – 4.00 (Very satisfied), 2.51 – 3.25 (Satisfied), 1.76 – 2.50 (Dissatisfied), & 1.00 – 1.75 (Very Dissatisfied).
2. To describe the perspective of students in Analytic Geometry and Calculus before using Desmos, the weighted mean together with its verbal interpretation was utilized, 3.26 – 4.00 (Strongly Agree), 2.51 – 3.25 (Agree), 1.76 – 2.50 (Disagree), & 1.00 – 1.75 (Strongly Disagree).
3. To describe the performance of students in Analytic Geometry and Calculus before using Desmos, the researcher adopted DepEd Order no. 8, s. 2015 titled Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program. The mean score together with its verbal interpretation was utilized, 90 – 100 (Outstanding), 85 – 89 (Very Satisfactory), 80 – 84 (Satisfactory), 75 – 79 (Fairly Satisfactory) & below 74 (Did not meet expectations).
4. To describe the perspective of students in Analytic Geometry and Calculus after using Desmos, the weighted mean together with its verbal interpretation was utilized, 3.26 – 4.00 (Strongly Agree), 2.51 – 3.25 (Agree), 1.76 – 2.50 (Disagree), & 1.00 – 1.75 (Strongly Disagree).
5. To describe the performance of students in Analytic Geometry and Calculus after using Desmos, the researcher adopted DepEd Order no. 8, s. 2015 titled Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program. The mean score together with its verbal interpretation was utilized, 90 – 100 (Outstanding), 85 – 89 (Very Satisfactory), 80 – 84 (Satisfactory), 75 – 79 (Fairly Satisfactory) & below 74 (Did not meet expectations).
6. To determine the significant difference in the students' perception of Analytic Geometry and Calculus before and after using Desmos, paired t-test for a significant difference was used.
7. To determine the significant difference in the students' performance of Analytic Geometry and Calculus before and after using Desmos, paired t-test for a significant difference was used.
8. To describe the utilization of Desmos, qualitative analysis was utilized.

RESULTS AND DISCUSSION

This section discusses the results of the series of instructions. This chapter shows the role of the Desmos Graphing Calculator (DGC) as technology in learning mathematics.

The Features of Desmos

To describe the features of Desmos, the general weighted mean together with the verbal interpretation were used.

1.1. Actions

Table 1.1 Actions

Actions	Mean Score	Verbal Interpretation
1. The Desmos' appearance of the graph is adjustable.	3.93	Very Satisfied
2. The Desmos' distance of the points is adjustable.	3.93	Very Satisfied
3. The Desmos' surface can be zoom in/out.	3.73	Very Satisfied

4. The Desmos equation's variables can be play/move/adjust that makes it easier to understand the graph.	3.67	Very Satisfied
5. The Desmos graphing calculator animation mode can be change and make it fast or slow.	3.73	Very Satisfied
6. The variables of the equation on Desmos can be played to easily understand the graph.	3.87	Very Satisfied
7. Adjustable variables in equations are helpful.	3.67	Very Satisfied
8. Editing equations in Desmos is not complicated.	3.47	Very Satisfied
9. Adjusting equations in Desmos is effortless.	3.47	Very Satisfied
10. Speed on the animation mode in Desmos can be modified.	3.60	Very Satisfied
General Weighted Mean:	**3.71**	**Very Satisfied**

Table 1.1 presents the mean scores and their verbal interpretations of actions as one of the features of Desmos. It shows a general weighted mean of 3.71 with a verbal interpretation of very satisfied. This indicates that the students are very satisfied with the actions that they can take on the application.

1.2. Color Appearance

Table 1.2. Color Appearance

Color Appearance	**Mean Score**	**Verbal Interpretation**
1. The Desmos customization of color is helpful to differentiate the line graph.	3.60	Very Satisfied
2. The Desmos custom color is helpful to distinguish equation of a graph.	3.73	Very Satisfied
3. The Desmos adjusting contrast in the plane helps me to visualize graphs in lined to my preference.	3.87	Very Satisfied
4. The Desmos customization of color can help to create an effective visualization of the graph.	3.73	Very Satisfied
5. The Desmos custom color is helpful to determine the points of a graph.	3.80	Very Satisfied
6. The Desmos customization of color is useful to easily recognize the line graph.	3.73	Very Satisfied
7. The Desmos has any color that supplies the color preferences.	3.73	Very Satisfied
8. The Desmos color appearance is a creative graphing.	3.67	Very Satisfied
9. Use custom colors to go beyond the default Desmos palette and add a personal touch to the graphs.	3.80	Very Satisfied
10. Color appearance of Desmos is new and enjoyable way of graphing.	3.67	Very Satisfied
General Weighted Mean:	**3.73**	**Very Satisfied**

Table 1.2. Shows the mean scores, and their verbal interpretation of color appears as one of the features of Desmos. The table revealed a general weighted mean of 3.73, with a verbal interpretation very satisfied. This means that the students are very satisfied with the color appearances they can modify on the application.

1.3. Plotting Equations

Table 1.3. Plotting Equations

Plotting equations	Mean Score	Verbal Interpretation
1. The Desmos specifications/selection of topic is helpful.	3.80	Very Satisfied
2. The Desmos plotting equation can be easily done, even without an internet connection.	3.40	Very Satisfied
3. The Desmos results showed is understandable.	3.73	Very Satisfied
4. The Desmos plotting equations is accurate.	3.80	Very Satisfied
5. The Desmos multiple equations can be graph clearly.	3.80	Very Satisfied
6. Choosing a specific topic from Desmos is very efficient.	3.80	Very Satisfied
7. Internet connection is not a problem when plotting equations in Desmos	3.20	Satisfied
8. Results shown in Desmos are comprehensible.	3.67	Very Satisfied
9. Plotting equations in Desmos are reliable.	3.80	Very Satisfied
10. Different equations can be graphed in Desmos.	3.80	Very Satisfied
General Weighted Mean:	**3.68**	**Very Satisfied**

Table 1.3 shows the mean scores and their verbal interpretation of the plotting equations as one of the features of Desmos. The table presents a weighted mean of 3.68, indicating that the students are very satisfied with plotting equations in Desmos.

2. The perspective of students in Analytic Geometry and Calculus before using the Desmos Graphing Calculator

To describe the perspective of students in Analytic Geometry and Calculus before using Desmos, the weighted mean together with its verbal interpretation was used.

Table 2. The perspective of students in Analytic Geometry and Calculus before using the Desmos Graphing Calculator

Before	Mean Score	Verbal Interpretation
1. Students think that graphing is entertaining.	3.13	Agree
2. Students enjoy graphing functions and equations in Analytic Geometry and Calculus.	3.13	Agree
3. Students think that it is easy to graph the equation of a line using slope-intercept.	3.07	Agree
4. Students think that it is easy to graph the equation of a line using point-slope intercept.	3.13	Agree
5. Students think that it is easy to graph a tangent line	3.00	Agree
6. Students think that it is easy to graph a derivative.	3.00	Agree
7. Students think that it is easy to graph the equation of a line using two-points.	2.93	Agree
8. Students spend a lot of time in finding the graph of an equation when it is handwritten.	3.07	Agree
9. Students are clueless about the Desmos app.	2.93	Agree
10. Graphs is influential in presenting functions and relationships in Analytic Geometry and Calculus.	3.40	Strongly Agree
General Weighted Mean:	**3.08**	**Agree**

Table 2 shows the mean scores and their verbal interpretation of the student's perspective before using Desmos. The above table presents a weighted mean of 3.08, indicating that the students Agree that graphing in Analytic Geometry and Calculus is entertaining and easy even without the help of an online graphing calculator.

3. The performance of students in Analytic Geometry and Calculus before using Desmos

To describe the performance of students in Analytic Geometry and Calculus before and after using Desmos, the mean score together with its verbal interpretation was used.

Table 3. Scores and Grades of students in Analytic Geometry and Calculus before using Desmos

Student	Scores	Grades	Verbal Interpretation
1	16	53.33	Did not meet the expectation
2	13	43.33	Did not meet the expectation
3	17	56.67	Did not meet the expectation
4	7	23.33	Did not meet the expectation
5	12	40.00	Did not meet the expectation
6	12	40.00	Did not meet the expectation
7	11	36.67	Did not meet the expectation
8	13	43.33	Did not meet the expectation
9	18	60.00	Did not meet the expectation
10	11	36.67	Did not meet the expectation
11	21	70.00	Did not meet the expectation
12	12	40.00	Did not meet the expectation
13	11	36.67	Did not meet the expectation
14	17	56.67	Did not meet the expectation
15	13	43.33	Did not meet the expectation
General Weighted Mean:	**13.60**	**45.33**	**Did not meet the expectation**

Table 3. Shows the scores and grades of students in Analytic Geometry and Calculus before using Desmos, with an average of 13.60, equivalent to 45.33. This indicates the students did not meet the expectations of DepEd Order No. 8, s. 2015 for the classroom assessment.

4. The perspective of students in Analytic Geometry and Calculus after using the Desmos Graphing Calculator

To describe the perspective of students in Analytic Geometry and Calculus before using Desmos, the weighted mean together with its verbal interpretation was used.

Table 4. The perspective of students in Analytic Geometry and Calculus after using the Desmos Graphing Calculator

After	Mean Score	Verbal Interpretation
1. Students think that graphing in entertaining.	3.53	Strongly Agree
2. Students enjoy graphing functions and equations in Mathematics.	3.60	Strongly Agree
3. Students think that it is easy to graph the equation of a line using slope-intercept.	3.67	Strongly Agree
4. Students think that it is easy to graph the equation of a line using point-slope intercept.	3.67	Strongly Agree
5. Students think that it is easy to graph a tangent line	3.67	Strongly Agree
6. Students think that it is easy to graph a derivative.	3.53	Strongly Agree
7. Students think that it is easy to graph the equation of a line using two-points.	3.27	Strongly Agree
8. Students can graph an equation in a quite time.	3.73	Strongly Agree
9. Students are happy about discovered Desmos and have used it for easy graphing an equation.	3.80	Strongly Agree
10. Graphs is more influential in presenting functions and relationships in mathematics.	3.80	Strongly Agree
General Weighted Mean:	**3.63**	**Strongly Agree**

Table 4 presents the mean scores and their verbal interpretation of the students' perspective after using Desmos. It shows a weighted mean of 3.63, indicating that the students strongly agree that Desmos in Analytic Geometry and Calculus is helpful in graphing.

5. The performance of students in Analytic Geometry and Calculus after using Desmos

To describe the performance of students in Analytic Geometry and Calculus before and after using Desmos, the mean score together with its verbal interpretation was used.

Table 5. Scores and Grades of students in Analytic Geometry and Calculus after using Desmos

Student	Scores	Grades	Verbal Interpretation
1	30	100.00	Outstanding
2	30	100.00	Outstanding
3	30	100.00	Outstanding
4	29	96.67	Outstanding
5	30	100.00	Outstanding
6	27	90.00	Outstanding
7	26	86.67	Very Satisfactory
8	29	96.67	Outstanding

9	27	90.00	Outstanding
10	27	90.00	Outstanding
11	29	96.67	Outstanding
12	28	93.33	Outstanding
13	30	100.00	Outstanding
14	27	90.00	Outstanding
15	24	80.00	Satisfactory
General Weighted Mean:	**28.20**	**94.00**	**Outstanding**

Table 5. Shows the scores and grades of students in Analytic Geometry and Calculus after using Desmos, with an average of 28.20, equivalent to 94.00. This indicates the students meet the expectations of DepEd Order No. 8, s. 2015 for the classroom assessment.

6. Significant difference in the student's perception of Analytic Geometry and Calculus before and after using Desmos

To get the significant difference in the student's perspective before and after using Desmos, the mean scores in tables 2 and 4 were used.

Table 6. Paired t-test for a significant difference in students' perception of Analytic Geometry and Calculus before and after using Desmos

t-Test: Paired Two Samples for Means

	Before	**After**
Mean	3.07	3.64
Variance	0.02	0.03
Observations	9.00	9.00
Pearson Correlation	0.46	
Hypothesized Mean Difference	0.00	
df	8.00	
t Stat	-10.54	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.86	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.31	

Table 6. Presents the result of the paired t-test is 0.00, with a level of significant difference of 0.05 and df = 8. The table shows that there is a significant difference in the perspective of the students before and after using the Desmos. It can be deduced based on the findings that the experimental group of BSED Mathematics majors had a better perspective in Analytic Geometry and Calculus with the use of the Desmos Graphing Calculator.

7. Significant difference in the students' performance in Analytic Geometry and Calculus before and after using Desmos

To get the significant difference in the student's performance before and after using Desmos, the mean scores in tables 3 and 5 were used.

Table 7. Paired t-test for a significant difference in students' performance of Analytic Geometry and Calculus before and after using Desmos

t-Test: Paired Two Sample for Means

	Pre-Test	Post-Test
Mean	13.43	28.07
Variance	13.03	3.30
Observations	14.00	14.00
Pearson Correlation	0.02	
Hypothesized Mean Difference	0.00	
df	13.00	
t Stat	-13.66	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.77	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.16	

Table 7. Presents the result of the paired t-test is 0.00, with a level of significant difference of 0.05 and df = 13. It shows that there is a significant difference in the performance of the students before and after using the Desmos. It can be deduced based on the findings that the experimental group, a BSED Mathematics major, performed better in Analytic Geometry and Calculus with the use of the Desmos Graphing Calculator.

8. The utilization of Desmos

Table 8.1. Teaching tool

Teaching Tool	Mean Score	Verbal Interpretation
1. Teachers can have an opportunity to improve their pre-service in mathematics' readiness to develop and apply technologies specifically Desmos.	3.93	Strongly Agree
2. Teachers can use Desmos activities build supports (scaffolds) to help people understand concepts or ideas.	3.93	Strongly Agree
3. Teachers can use it Desmos to create high-quality graphics for assessments and presentations.	3.87	Strongly Agree
4. Teachers can use Desmos better and easily when teaching graphs.	3.93	Strongly Agree
5. Teachers can use Desmos when teaching variety of graphs.	3.80	Strongly Agree
6. Teachers can use Desmos to present mathematical concepts effectively.	3.80	Strongly Agree
7. Teachers can use Desmos to connect mathematical representations.	3.87	Strongly Agree
8. The Desmos activities helps the teachers in allowing the students to build authentic life skills, which they can use in their everyday lives.	3.93	Strongly Agree
9. Desmos educational technology enable teachers to present mathematical concepts effectively.	3.80	Strongly Agree
10. Desmos helps teachers to have a better graphing demonstration.	3.80	Strongly Agree
General Weighted Mean:	**3.87**	**Strongly Agree**

Table 8.1. Shows the mean scores and their verbal interpretation of the utilization of Desmos as teaching tools. It revealed that the students strongly agree with the utilization of Desmos as a teaching tool, with a weighted mean of 3.87.

8.2 Learning tool

To describe the utilization of Desmos as a learning tool, the weighted mean together with its verbal interpretation was used.

Table 8.2 Learning tool

Learning Tool	Mean Score	Verbal Interpretation
1. Students can use Desmos activities to bridge the gap between their learning at school and their day-to-day lives	3.80	Strongly Agree
2. Students can use Desmos activities to assist them to concentrate on their assignments or hobbies by removing distractions.	3.80	Strongly Agree
3. Students can use Desmos exercises as an encouragement to begin the learning process.	3.80	Strongly Agree

4. Students' behavior shifts from passive to active social learners as a result of the Desmos exercises.	3.87	Strongly Agree
5. Students can use Desmos activities to help them develop or demonstrate a more complex idea. Sophisticated comprehension of the learning objectives or content	3.80	Strongly Agree
6. Students can use Desmos exercises to allow them to demonstrate their understanding of the learning objectives in ways that traditional tools do not allow.	3.73	Strongly Agree
7. Students can use Desmos activities to creates opportunities for them to learn outside of their typical school day.	3.73	Strongly Agree
8. Students use Desmos as a good learning tool when practicing and or doing graphs.	3.53	Strongly Agree
9. The Desmos activities causes a shift in the behavior of the students, where they move from passive to active social learners.	3.73	Strongly Agree
10. The Desmos activities allows students to be able to develop or demonstrate a more sophisticated understanding of the learning goals or content.	3.80	Strongly Agree
General Weighted Mean:	**3.76**	**Strongly Agree**

Table 8.2. The next page shows the mean scores and their verbal interpretation of the utilization of Desmos as learning tools. It shows that the students strongly agree on the utilization of Desmos as a learning tool, with a weighted mean of 3.76.

4. CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The study examines the impact of using Desmos Graphing Calculator as a teaching and learning tool in Analytic Geometry and Calculus among BSED Mathematics majors. It finds that students in the experimental group exhibit high satisfaction with Desmos' features, such as action, color appearance, and equation plotting. Their perspective on these subjects significantly improves with Desmos compared to traditional methods, indicating its effectiveness as a teaching aid. Additionally, the students' performance meets the expectations of the DEPED Order for classroom assessment, suggesting Desmos enhances their learning outcomes. Overall, the study concludes that integrating Desmos into instruction positively influences students' perspectives and performance in Analytic Geometry and Calculus, underscoring its efficacy as a technological tool in mathematics education.

Recommendations

The researchers offer several recommendations for future studies based on their findings regarding the use of Desmos Graphing Calculator in Analytic Geometry and Calculus education. They suggest exploring alternative technological tools to Desmos for teaching these subjects, aiming to diversify instructional approaches. Additionally, they propose conducting similar studies with two groups to enhance result accuracy, alongside utilizing interviews to delve deeper into student perspectives. Furthermore, integrating real-life or situational problems into assessments is recommended to better gauge student performance. Educators

teaching Analytic Geometry and Calculus are encouraged to consider incorporating Desmos and problem-solving techniques it offers into their teaching practices. Moreover, the researchers advocate for extending similar studies to other branches of mathematics and different year levels or courses to validate findings across varied contexts. Lastly, they emphasize the importance of replicating the study with larger sample sizes to verify the consistency of results. These recommendations collectively aim to enrich understanding and application of Desmos and similar tools in mathematics education, fostering improved learning outcomes.

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