



Diamond Math Method on Students' Performance in Factoring Quadratic Trinomials and Mathematics Resiliency

Christine C. Zapanta^{1*}, Lalace Lin W. Ga-as², Dr. Jenyliza T. Uchang³

Science Education Department, Central Mindanao University, University Town, Musuan, Bukidnon, 8714 Philippines

Correspondence Tel.: +639355773122,

*Email: christinecastillon121496@gmail.com

Abstract. Students' mathematics learning requires several techniques to better learn and perform in class. This study examined students' performance in factoring trinomials and their mathematics resiliency using Diamond Math Method (DMM) intervention. Sixty (60) Grade 10 students from the two sections of Kitatang National High School, Don Carlos, Bukidnon, completed a researcher-made questionnaire to measure quadratic trinomial factoring and an adapted questionnaire to measure mathematics resiliency. The study employed a quasi-experimental design. The experimental group is assigned as DMM, and the controlled group as non-DMM. After the study: (1) The DMM group performs better at factoring quadratic trinomials than the Non-DMM group, (2) the Non-DMM group has higher mathematics resiliency than those exposed to the Diamond Math Method, (3) there is a significant difference in students' performance in factoring quadratic trinomials, and (4) there is also a significant difference in the students' mathematics resiliency. Thus, DMM effectively improves students' performance in factoring quadratic trinomials and enhancing their resilience in mathematics.

Keywords: Diamond math method, factoring quadratic trinomials, mathematics resiliency

1 Introduction

Mathematics education refers to the process of teaching and learning mathematics. From kindergarten to graduate school, it involves formal and informal learning. Math education helps students learn, apply, and reason numerically. Effective mathematics instruction requires both procedural proficiency and conceptual comprehension. It also requires engaging students in meaningful and relevant mathematical problems, employing a variety of instructional methodologies and resources, and giving math collaboration and communication opportunities.

As outlined in the conceptual framework of the K to 12 Basic Education Curriculum, the Mathematics Education provided to secondary school students in the Philip-

pires aims to foster proficiency in a range of individual skills, including but not limited to, knowing and comprehending mathematical concepts, estimating and computing numerical problems, visualizing and modeling mathematical scenarios, representing and effectively communicating mathematical ideas, formulating and testing conjectures, utilizing sound reasoning and proof techniques, making informed decisions, and connecting mathematical concepts to real-world problems (Villanueva, MJ. et. al., 2022).

The Department of Education's mathematics curriculum covered factoring algebraic expressions and equations before the K-12 curriculum. Binomials and trinomials were the basic algebraic expressions in which factoring is applied. According to Chung (2012) factoring quadratic trinomial, which requires rewriting ax^2+bx+c into the form $(mx+n)(px+q)$, is one of the most challenging algebraic tasks for students in the high school especially when the leading coefficient a is greater than 1. Most teachers find quadratic factoring hard to explain, thus many students memorize algebra. Factoring requires multiplication, division, addition, subtraction, and positive and negative sign operations. Students must grasp basic algebra operations before factoring quadratics. Learning mathematics is considered by many students to be really tough and challenging much more in the new normal (Agtarap & Miranda, 2022). Learning new techniques requires great courage, consistency, and willingness to learn despite the adversities to be encountered. Dealing with mathematics needs an attribute which is resiliency. Implementing learning with methods that are different from usual will certainly impact students positively and negatively (Rahayu et. al., 2020). Math resilience is a student's capacity to reflect and make informed decisions in unfamiliar, unexpected situations. Environmental influences and problem-solving styles affect student resilience. In factoring quadratic trinomials, students may have been hampered by the epidemic and different learning modes.

Several techniques have been developed to simplify the process of factoring quadratic trinomials, including the cross method, grouping method, tool-based geometric approach, and others. According to Tok (2015), teaching creatively might be described as teachers using imaginative approaches to make learning more interesting, engaging, exciting, and effective. The Diamond Math Method is an additional approach to factoring trinomials that can be used by students and teachers in math classes. It is a unique and creative way of factoring quadratic trinomials. This method is named diamond because it takes the form of a diamond shape, divided into four parts, with each part representing a corresponding value for input.

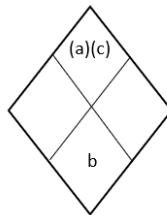


Fig. 1. Diamond Math Method

Basic operational skills are then performed on the top and bottom portions of the diamond. Math teachers are unfamiliar about the Diamond Math Method because they've been using other methods or the standard approach to teach it. The diamond math method has not been studied before, thus the current study will use it to improve students' quadratic trinomial factoring and mathematics resiliency.

2 Methodology

This study was quasi-experimental. The researcher compared experimental and control groups using nonequivalent-group designs. This study was conducted at the rural Barangay Kibatang, Municipality of Don Carlos, Bukidnon, Kibatang National High School. This investigation used two instruments. First, the researcher-made quadratic trinomial factoring test comprised five items. Three local experts assessed the instrument's clarity, appropriateness, and complexity. An adapted rubric gave each item 5 points. The second instrument was an adapted mathematics resiliency questionnaire with 23 items separated into three factors: value, struggles, and growth, with reliability values of .942, .706, and .829. The measure employed a 7-point Likert scale. The following scale was used to better understand the data:

Level of Proficiency	Range Scale	Interpretation
Exemplary	90%-100%	Very High Performance
Above Average	86%-89%	High Performance
Average	80%-85%	Moderate Performance
Below Average	75%-79%	Low Performance
Deficient	65%-74%	Very Low Performance

Scale	Mean Range	Descriptive Rating	Qualitative Interpretation
7	6.16 – 7.00	Completely Agree	Very High Resilience
6	5.30 – 6.15	Agree	High Resilience
5	4.44 – 5.29	Somewhat Agree	Above Average Resilience
4	3.58 – 4.43	Neutral	Average Resilience
3	2.72 – 3.57	Somewhat Disagree	Below Average Resilience
2	1.86 – 2.71	Disagree	Low Resilience
1	1.00 – 1.85	Completely Disagree	Very Low Resilience

3 Results and Discussion

This section presents tables, analyzes, and interprets data from DMM and Non-DMM groups. This section summarizes students' performance in factoring quadratic trinomials, and mathematics resiliency in terms of value, challenges, and growth.

3.1 Performance in Factoring Quadratic Trinomials of the Students Exposed to DMM and Non-DMM

Table 1 presents the performance level of the students in factoring quadratic trinomials when exposed to DMM and Non-DMM methods.

Table 1. Level of students' performance in factoring quadratic trinomials in terms of understanding the problem

Range	DR	GROUP								QI
		DMM n=30				Non-DMM n=30				
		Pretest		Posttest		Pretest		Posttest		
f	%	f	%	F	%	f	%			
90%-100%	VH			10	34%			2	7%	O
80%-89%	H			3	10%			1	3%	VS
70%-79%	M			1	3%			7	23%	S
60%-69%	L			12	40%			8	27%	FS
Below 59%	VL	30	100%	4	3%	30	100%	12	40%	DE
		29.45%		74.8%		28.8%		60.67%		

Both DMM and Non-DMM students performed poorly in factoring quadratic trinomials on the pretest. The mean DMM and Non-DMM classes are 29.45% and 28.8%, respectively. Both courses failed, indicating that students cannot factor quadratic trinomials. Students struggled factoring quadratic trinomials.

The pretest findings show that factoring quadratic trinomials is one of the hardest algebraic tasks in high school mathematics (Villanueva et al., 2022). DMM-exposed children performed better at factoring quadratic trinomials. Students exposed to the DMM scored 74.8% on quadratic trinomial factoring, indicating moderate or satisfactory. The mean percentage score of Non-DMM students was 60.67%, indicating low or fairly satisfactory. The DMM appears to more improve students' factoring quadratic trinomials performance, with a higher number of students attaining outstanding and very satisfactory outcomes and a lower percentage failing to meet expectations. These results suggest that the DMM approach improves quadratic trinomial factoring. This outcome is comparable to an X-box technique (Villanueva et al., 2022).

3.2 Mathematics Resiliency of Students Before Intervention

Table 6 displays the result of students' math resiliency in terms of value before the intervention of the Diamond Math Method.

Table 2. Level of students’ mathematics resiliency in terms of value

Value	GROUP					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Math will be useful to me in my life’s work.	5.77	Agree	HR	5.13	Slightly Agree	AAR R HR
Math develops good thinking skills that are necessary to succeed in any career.	5.63	Agree	HR	5.93	Agree	
It would be difficult to succeed in life without math.	5.53	Agree	HR	5.67	Agree	HR
Math is essential for my future.	5.50	Agree	HR	5.77	Agree	HR
Math courses are very helpful no matter what I decide to study.	5.07	Slightly Agree	AA R	5.77	Agree	HR
Knowing math contributes greatly to achieving my goals.	4.90	Slightly Agree	AA R	5.13	Slightly Agree	AA R HR
Having a solid knowledge of math helps me understand more complex topics in my field of study.	4.90	Slightly Agree	AA R	5.73	Agree	
Thinking mathematically can help me with things that matter to me.	4.80	Slightly Agree	AA R	5.0	Slightly Agree	AA R
OVERALL	5.26	Agree	HR	5.52	Agree	HR

The data suggest that both the DMM group and the Non-DMM group recognize the value of mathematics in their future careers and life in general. However, the DMM group had lower mean scores for the items related to their interest and curiosity in mathematics.

Table 3. Level of students’ mathematics resiliency in terms of struggles

Struggles	Group					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Everyone struggles with math at some point.	5.10	Slightly Agree	AAR	5.17	Slightly Agree	AAR
Good mathematicians experience difficulties when solving problems.	4.83	Slightly Agree	AAR	4.50	Slightly Agree	AAR
People who work in math-related fields sometimes find math challenging.	5.30	Agree	HR	5.37	Agree	HR
Everyone makes mistakes at times when doing math.	5.43	Agree	HR	5.83	Agree	HR
Struggle is a normal part of working on math.	5.47	Agree	HR	6.17	Completely Agree	VHR
People in my peer group struggle sometimes with math.	5	Slightly Agree	AAR	5.10	Slightly Agree	AAR
People who are good at math may fail a hard math test.	4.30	Neutral	AR	4.77	Slightly Agree	AAR
Making mistakes is necessary to get good at math.	5.10	Slightly Agree	AAR	4.77	Slightly Agree	AAR
OVERALL	5.07	Slightly Agree	AAR	5.21	Slightly Agree	AAR

The data suggests that students in both groups believe arithmetic achievement is based on effort and hard work rather than intrinsic talent. The results show that the two groups have different beliefs on math learning problems. The DMM group’s highest means are related to accepting that mathematics learning involves struggle and mistakes. The results imply that the DMM group may be more positive about failing and making mistakes in math, which may help them succeed.

Table 4. Level of students' mathematics resiliency in terms of growth

Growth	Group					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Math can be learned by anyone.	6.10	Agree	HR	6.37	Completely Agree	VHR
If someone is not a math person, they won't be able to learn much math.	3.37	Slightly Disagree	BAR	4.33	Neutral	AR
If someone is not good at math, there is nothing that can be done to change that.	3	Slightly Disagree	BAR	3.93	Neutral	AR
People are either good at math or they aren't.	4.67	Slightly Agree	AAR	4.23	Neutral	AR
Everyone's math ability is determined at birth.	3.10	Slightly Disagree	BAR	3.37	Slightly Disagree	AAR
Some people cannot learn math.	3.13	Slightly Disagree	BAR	2.77	Slightly Disagree	BAR
Only smart people can do math.	2.20	Disagree	LR	2.20	Disagree	LR
OVERALL	3.65	Neutral	AR	3.89	Neutral	AR

Table 4 displays the result of students' math resiliency in terms of growth before the intervention of the Diamond Math Method. The data suggest that both DMM and Non-DMM groups appreciate the importance of effort and hard work in mathematical performance. The DMM group may have a more modest perspective of their mathematical skills, while the Non-DMM group may have a more diversified outlook.

3.3 Mathematics Resiliency of Students After Intervention

Table 5 shows the level of Mathematics resiliency in terms of value after the intervention.

Table 5. Level of students' mathematics resiliency in terms of value

Value	GROUP					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Math is essential for my future.	6.47	Completely Agree	VHR	6.10	Agree	HR
Math will be useful to me in my life's work.	6.10	Agree	HR	6.17	Completely agree	HR
Knowing math contributes greatly to achieving my goals.	5.80	Agree	HR	6.03	Agree	HR
Math develops good thinking skills that are necessary to succeed in any career.	5.80	Agree	HR	5.87	Agree	HR
Math courses are very helpful no matter what I decide to study.	5.43	Agree	HR	6.10	Agree	HR
Having a solid knowledge of math helps me understand more complex topics in my field of study.	5.40	Agree	HR	5.90	Agree	HR
Thinking mathematically can help me with things that matter to me.	5.20	Slightly Agree	AAR	5.87	Agree	HR
It would be difficult to succeed in life without math.	4.70	Slightly Agree	AAR	5.90	Agree	HR
OVERALL	5.61	Agree	HR	5.99	Agree	HR

Math seemed significant to the students since they knew it would help them accomplish their goals. Every math class emphasizes that mathematics is everywhere and

essential to daily life. The intervention also increased both groups' pretest and posttest mean in terms of value.

Math resiliency after the intervention is 5.61 for DMM students and 5.99 for non-DMM students. Students are resilient in math. Non-DMM has a higher mean than DMM. The results suggest that both groups are persistent and adaptable arithmetic learners and perceive Math essential to students' life.

Table 6. Level of students' mathematics resiliency in terms of struggles

Struggles	Group					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Good mathematicians experience difficulties when solving problems.	5.83	Agree	HR	6.07	Agree	HR
People who work in math-related fields sometimes find math challenging.	5.63	Agree	HR	5.67	Agree	HR
Everyone makes mistakes at times when doing math.	5.43	Agree	HR	6.37	Slightly Agree	AAR
Struggle is a normal part of working on math.	5.67	Agree	HR	6.27	Completely Agree	VHR
People in my peer group struggle sometimes with math.	5.40	Agree	HR	5.70	Agree	HR
People who are good at math may fail a hard math test.	4.83	Slightly Agree	AAR	5.17	Slightly Agree	AAR
Making mistakes is necessary to get good at math.	5.37	Agree	HR	5.67	Agree	HR
Everyone struggles with math at some point.	4.67	Slightly Agree	AAR	6.23	Completely Agree	VHR
OVERALL	5.35	Agree	HR	5.89	Agree	HR

The DMM group firmly believed in struggling and making math mistakes after the intervention. DMM intervention may have substantial impact on students' beliefs in terms of Struggle. While the Non-DMM group maintained strong ideas about the value of struggling and making mistakes in mathematical learning,

Table 7. Level of students' mathematics resiliency in terms of growth

Growth	Group					
	DMM n=30			Non-DMM n=30		
	Mean	DR	QI	Mean	DR	QI
Math can be learned by anyone.	6.63	Completely Agree	VHR	6.87	Completely Agree	VHR
If someone is not a math person, they won't be able to learn much math.	3.13	Slightly Disagree	BAR	4.13	Neutral	AR
If someone is not good at math, there is nothing that can be done to change that.	2.60	Disagree	LR	3.43	Neutral	AR
People are either good at math or they aren't.	4.67	Slightly Agree	AAR	5.47	Agree	HR
Everyone's math ability is determined at birth.	3.30	Slightly Disagree	AAR	3.90	Neutral	AR
Some people cannot learn math.	3.20	Slightly Disagree	AAR	3.73	Neutral	AR
Only smart people can do math.	2.53	Disagree	LR	2.57	Disagree	LR
OVERALL	3.72	Neutral	AR	4.30	Neutral	AR

Both groups are consistent in their belief that mathematical ability is malleable and can be developed through effort and hard work.

3.4 Summary of Students' Mathematics Resiliency Before and After the Intervention

Table 8 shows the importance, challenges, and advancement of DMM and Non-DMM students. As indicated in the table, the DMM group's worth, challenges, and progress mean 5.26, 5.07, 3.65, and 4.66, respectively. This suggests that DMM students had above-average resiliency before the intervention. After implementing the Diamond Math Method, their mean values, struggles, and growth are 5.61, 5.35, 3.72, and 4.89, respectively. The pretest and posttest show a slight change, but the DMM group has above-average math resiliency.

Table 8. The pretest and posttest

STUDENTS' MATHEMATICS RESILIENCY	Group							
	DMM n=30				Non-DMM n=30			
	Pretest	QI	Posttest	QI	Pretest	QI	Posttest	QI
Value	5.26	AAR	5.61	HR	5.52	HR	5.99	HR
Struggles	5.07	AAR	5.35	AAR	5.21	AAR	5.89	HR
Growth	3.65	AR	3.72	AR	3.89	AR	4.30	AR
OVERALL	4.66	AAR	4.89	AAR	4.87	AAR	5.39	HR

The Non-DMM group's value, struggles, and growth mean 5.52, 5.21, 3.89, and 4.87, respectively, with an overall mean of 4.87, indicating that before the traditional way of factoring quadratic trinomials, the students had above-average resiliency and could handle difficult tasks and unfamiliar concepts. After the traditional intervention, their posttest scores for value, struggle, and growth were 5.52, 5.21, 3.89, and 4.87, respectively, with an overall mean of 4.87. The Non-DMM group's mathematics resiliency increased to 5.99, 5.89, 4.30, and 5.39, respectively. The Non-DMM group's pretest and posttest means increase from above average resilience to high resilience, suggesting that the traditional technique improves their resiliency in dealing quadratic trinomial factoring.

The Non-DMM group has stronger mathematics resiliency than the DMM group based on their overall means. Because the diamond math approach makes factoring quadratic trinomials easier, students' performance improved but their resiliency did not. Mathematic resilience comprises the ability to see how tough times can help one progress (Hutauruk & Priatna, 2017).

3.5 Analysis of Covariance (ANCOVA) of Posttest in Students' Performance in Factoring Quadratic Trinomials Between Intervention

Table 9 shows the posttest ANCOVA between treatments. As demonstrated in the table below, the pretest was employed as a covariate to statistically equate prognostic variables that may affect data analysis. The null hypothesis that students exposed to diamond math method perform similarly to those exposed to nondiamond math meth-

od in posttest factoring quadratic trinomials is rejected because the F-value between groups is 13.865 with a significance value of.000**.

Table 9. Comparison of students’ performance in factoring quadratic trinomials on the posttest

GROUP	N	MEAN	SD
DMM	30	18.33	4.120
Non-DMM	30	15.17	4.334
TOTAL	60	16.75	4.486

Source	SS	df	MS	F-value	Sig.
Group	170.088	1	170.088	13.865	.000 ^s
Pre-test	337.568	1	337.568	27.517	.000 ^s
Error	699.265	57	12.268		
Total	18021	60			

Note: ^sSignificant at 0.05 level

The DMM group's pretest and posttest scores in factoring quadratic trinomials are 18.33 (SD=4.120) and 15.17 (SD=4.334), respectively. Both groups' posttest increased. As shown in Table 5, both groups' pretest scores were very low in factoring quadratic trinomials, but the DMM group showed a larger rise than the non-DMM group. The null hypothesis is rejected since the F-value between groups is 13.865 with a probability of.000 ($p > .05$), showing a significant difference. This shows that the Diamond Math Method is an effective method for factoring quadratic trinomials. Unlike the Non-DMM group, which was exposed to the traditional method, the DMM group had a guide for what to put in each box, making factoring easier. Table 13 shows that DMM pupils outperformed Non-DMM students.

Moreover, Tok (2015) found that creative teaching involves discovering new methods to do familiar activities. Every arithmetic technique has its own way of making tasks easier and more fun. The new strategy improved students factoring knowledge. Thus, the diamond math method should be taught in math classes, especially for factoring quadratic trinomials.

3.6 Difference in the Students’ Mathematics Resiliency when exposed to DMM and Non-DMM

Table 10 shows the mathematics resiliency ANCOVA between interventions. As demonstrated in the table below, DMM students had a mean mathematics resiliency of 4.948 (SD=.570) while Non-DMM students had 5.4420 (SD=.437). It shows that the pretest had a significance level of.000, indicating that students in both groups had statistical difference levels of mathematics resiliency before the intervention. The table also shows an F-value of 18.057 with a significance level of.036 for mathematics resiliency after an intervention, rejecting the null hypothesis that there is no significant difference between DMM and non-DMM students.

GROUP	N	MEAN	SD
DMM	30	4.9478	.570
Non-DMM	30	5.4420	.437
TOTAL	60		

Source	SS	df	MS	F-value	Sig.
Group	4.381	1	4.381	18.057	.036*
Pretest	1.125	1	1.125	4.637	.000*
Error	13.829	57	.243		
Total	1637.854	60			

Note: *Significant at 0.05 level

Table 14 shows that both groups' mathematics resiliency increased, with the DMM group averaging 4.89 and the Non-DMM group 5.39. The Non-DMM group had a higher posttest mean than the DMM group, indicating that students who factored trinomials traditionally exerted more effort in dealing with the tasks. The two groups' posttest means increased, indicating that students can handle crises and adversity (Wu et al., 2013). Thus, DMM students are less math resilient than non-DMM students. Students in DMM group need more difficult quadratic trinomials from teachers.

4 Conclusions and Recommendations

This study found that Diamond Math Method (DMM) is effective method to improve students' performance in factoring quadratic trinomials and mathematics resiliency. Teachers should also use innovative methods like Diamond Math Method to enhance students' understanding and performance to familiar tasks. In teaching mathematics, students must be welcome to acknowledge the struggles and difficulties in solving mathematical expressions. Also, students must be taught that intelligence and abilities can be developed through diligent effort and commitment. With the proper guidance of educators, students can grow and can aid students in overcoming obstacles and persisting in their studies, resulting in enhanced mathematics performance and mathematics resiliency.

References

1. Villanueva, M. J., Tinambacan, M. G., Lopez, C., & Saranza, C. (2022). *Students' performance in factoring quadratic trinomials through the x-box method*. European Journal of Humanities and Educational Advancements (EJHEA), 3(6). <https://www.scholarzest.com>
2. Chung, W. H. P. (2012). *A case study on teaching and learning of quadratic factoring*. Po Leung Kuk Celine Ho Yam Tong College. http://www.hkame.org.hk/new_html/uploaded_files/magazine/33/503.pdf
3. Agtarap, R., & Miranda, A. T. (2022). *The mediating effect of students' resiliency on the relationship of self-concept and mathematics performance*. Asian Journal of Education and Social Studies, 1–10. <https://doi.org/10.9734/ajess/2022/v36i2772>
4. Rahayu GDS, Altaftazani DH, Kelana JB, Firdaus AR, Fauzi MR. *Analysis of elementary school students' mathematical resilience during learning during the covid 19 Pandemic*. In Journal of Physics: Conference Series. IOP Publishing. 2020;1657(1)012001.
5. Tok, Ş. (2015). *The effects of teaching mathematics creatively on academic achievement, attitudes towards mathematics, and mathematics anxiety*. International Journal of Innova-

tion in Science and Mathematics Education, 23(4), 1–24.
<http://acikerisim.pau.edu.tr:8080/xmlui/handle/11499/10328>

6. Wu, G., Feder, A., Cohen, H., Kim, J. J., Calderon, S., Charney, D. S., & Mathé, A. A. (2013). *Understanding resilience. frontiers in behavioral neuroscience*, 7(10).
<https://doi.org/10.3389/fnbeh.2013.00010>

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

