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THE EFFECTS OF MATHEMATICS IN CONTEXT LEARNING AND A SMART NUMAFIT-ASSISTED FLIPPED CLASSROOM ON STUDENTS' NUMERACY SKILLS IN TERMS OF MATHEMATICAL RESILIENCE

Ayu Fitri¹, Turmudi^{2*}, Al Jupri², Arie Rakhmat Riyadi¹, Wahyudin¹

¹Department of Primary Education, Universitas Pendidikan Indonesia, Bandung, Indonesia.

²Department of Mathematics Education, Universitas Pendidikan Indonesia, Bandung, Indonesia.

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Corresponding Author: Turmudi
(turmudi@upi.edu)

ABSTRACT

Numeracy skills are essential competencies for navigating daily life and actively participating in society. However, national data indicate that the numeracy skills of elementary school students in Indonesia remain moderate, particularly in geometry and algebra. This study aims to examine the effects of the mathematics in context learning model and the flipped classroom approach supported by the interactive learning media Numafit on students' numeracy skills in relation to their level of mathematical resilience. This research employed a quantitative method using a 3×2 factorial quasi-experimental design. The participants were fifth-grade students from two public elementary schools in Karawang Regency, Indonesia, selected through purposive sampling. Students' numeracy skills were measured using a test instrument developed in accordance with the Indonesian Ministry of Education and Culture's numeracy framework. The findings reveal that both the mathematics in context and flipped classroom approaches have a significant effect on improving students' numeracy skills, with the mathematics in context model producing higher outcomes. Furthermore, an interaction effect was identified between the learning model and students' levels of mathematical resilience on their numeracy achievement. These findings suggest that digitally supported contextual learning aligned with students' psychological characteristics can be an effective strategy for comprehensively enhancing numeracy skills.

KEYWORDS: Numeracy; Mathematics in Context; Flipped Classroom; Numafit; Mathematical Resilience.

1 INTRODUCTION

Numeracy skills are among the key competencies students must master to face the challenges of the 21st Century. Numeracy is not merely about calculating, but also encompasses the ability to understand, interpret, analyze, and use mathematical information in various everyday and professional contexts (OECD, 2019). Unfortunately, Indonesian students' numeracy achievement in international assessments such as PISA remains low, indicating that they are not yet able to apply mathematical concepts authentically and functionally. This situation is worsened by the mathematics learning model in elementary schools, which remains procedural, lacking context, and offers little space for exploration and meaningful problem-solving. Therefore, improving numeracy skills has become a strategic priority in basic education, especially through the development of more contextual, interactive, and relevant learning models that address real-life needs. Various experts have put forward theoretical understandings of numeracy. Karaali *et al.*, (2016) view numeracy as a multidimensional competence that includes four aspects, namely quality of desired outcome (the ability to achieve correct numerical solutions through basic mathematical skills), knowledge Domain (mastery of the arithmetic, mathematical, quantitative, and logical domains in an integrated manner), display of expertise (the ability to understand, respond, and choose numeracy strategies), and context (the ability to apply numeracy in real-life situations). Meanwhile, NAPLAN (2012) put forward four other numeracy indicators, namely mastery of mathematical concepts such as numbers, patterns, space, data, and measurement; the ability to communicate mathematically through appropriate symbols, language, and representations; the ability to recognize the interconnection of mathematics with other disciplines as well as life phenomena; and the ability to apply numeracy in authentic contexts to solve everyday problems. Both conceptual frameworks provide a strong theoretical basis for formulating numeracy indicators that can be measured operationally.

Based on the integration of these numeracy theories, this study formulates operational numeracy indicators that cover four domains, namely Basic Skill Numeracy, which includes the ability to perform basic arithmetic operations and use mathematical symbols accurately; Problem and Formulation, which includes the ability to identify problems from real situations and formulate

strategies to solve them; Communication and Interpretation, which describes the ability to read, interpret, and communicate mathematical information in various representations; and Application in Context which includes the ability to apply numerical information in decision-making in the context of everyday life, social, work, and scientific situations. The formulation of this indicator ensures that the measurement of numeracy in research is more comprehensive and in accordance with the needs of elementary school mathematics learning.

Efforts to improve numeracy require a learning model that connects mathematical concepts to students' real experiences. One relevant approach is mathematics in context, a learning model based on Realistic Mathematics Education that views mathematics as a human activity and places authentic context at the centre of learning. The process of progressive mathematization in context encourages students to move from informal strategies to formal concepts through meaningful contexts, model representations, interactive discussions, and structured mathematical reasoning (Gravemeijer, 1994). This approach is very promising for improving numeracy skills, especially in problem-solving and applying concepts. In addition to the contextual approach, learning that utilizes digital technology is now being developed through the flipped classroom model. In a flipped classroom, students study the material first through videos, digital modules, or interactive media outside the classroom so that face-to-face time can be focused on collaborative activities, discussions, and in-depth problem-solving (Bergmann & Sams, 2012). Various studies show that the flipped classroom model effectively increases motivation, conceptual understanding, student engagement, and digital literacy (Putri *et al.*, 2026). The integration of mathematics in context and a flipped classroom opens up opportunities for context-rich learning while facilitating technology-based independent learning.

The effectiveness of these two approaches is reinforced by the Smart Numafit digital module, a numeracy learning module that provides interactive exercises, concept visualizations, and automatic feedback. This module is designed according to multimedia learning principles such as segmentation, contiguity, modality, and interactivity, which have been proven to enhance students' conceptual understanding and engagement (Chatzidaki *et al.*, 2025). Several studies indicate that digital and web-based

modules are effective in improving digital literacy, conceptual understanding, and student learning outcomes (Herlandy & Syahfutra, 2025; Ismail et al., 2024; Putri et al., 2026). Thus, Smart Numafit is a digital medium that supports improving students' numeracy through mathematics-in-context learning and a flipped classroom.

In addition to cognitive factors, numeracy learning success is influenced by affective factors, particularly mathematical resilience. According to Kookan et al. (2013), mathematical resilience is characterized by four main indicators: value, struggle, growth, and resilience. Value reflects students' appreciation of the importance of mathematics, whether due to intrinsic or extrinsic motivation (OECD, 2019). Struggle shows students' ability to face and overcome mathematical difficulties, in line with the theory of agency (Bandura, 1989; 2000) on self-control in the face of challenges. Growth refers to the belief that mathematical ability can be developed through effort, as emphasized in the incremental theory of ability (Yeager & Dweck, 2012).

Meanwhile, resilience describes students' ability to remain adaptive and persevere in the face of pressures in learning mathematics. These four indicators provide an important psychological foundation that enhances students' perseverance, self-confidence, and ability to tackle numeracy problems. If examined from the state of the art, although there are many studies on digital learning, contextual approaches, and flipped classroom learning (Chatzidaki et al., 2025), there has not been a study that comprehensively integrates mathematics in context, flipped classroom, and the Smart Numafit digital module and reviews it based on students' mathematical resilience. Thus, a significant research gap remains that requires further empirical study.

2 METHOD

Based on the research objectives and questions, the method in this study is quantitative, quasi-experimental, using a one-group pretest-posttest experimental design and a 3 x 2 factorial design. To

classify students by their level of mathematical resilience, students were given a questionnaire (the mathematical resilience questionnaire). In the research design, there is an experimental group with the mathematics in context learning treatment and a control group with the flipped classroom learning treatment assisted by Numafit. To classify students by their level of mathematical resilience, students were given a mathematical resilience questionnaire, and the results were subsequently grouped into three levels: high, medium, and low. The population in this study comprises numeracy and mathematical resilience scores of fifth-grade elementary school students in Karawang Regency, West Java.

Meanwhile, the sample in this study comprises numeracy and mathematical resilience scores of fifth-grade students from two public elementary schools in Karawang Regency, West Java Province. The sampling procedure in this study used purposive sampling, meaning the sample was not randomly selected but was selected directly from two classes to make it easier for the researcher to access. Each of the two samples received different treatments: the first as the experimental class and the second as the control class. The variables in this study include dependent and independent variables. The dependent variables in this study are numeracy skills and mathematical resilience. Meanwhile, the independent variables are mathematics in context learning assisted by numafit and flipped classroom learning assisted by numafit. The instruments in this study consist of tests (numeracy) and questionnaires (mathematical resilience).

3 RESULTS AND DISCUSSION

Results

To answer research question number 1 related to students' acquisition of numeracy skills who have studied mathematics in context and students who received learning with the flipped classroom, the researcher conducted a descriptive analysis of the students' numeracy skill scores, using SPSS version 31 software related to descriptive statistics, with the output as follows:

Table 1: Output of Descriptive Analysis of Students' Numeracy Skills Acquisition Based on Learning Treatment.

Descriptive Statistics			
		Posttest Scores of Numeracy Skills after Mathematics in Context Learning	Posttest Scores of Numeracy Skills after Flipped Classroom Learning
N	Statistic	43	46
Range	Statistic	33	46
Minimum	Statistic	67	54
Maximum	Statistic	100	100
Sum	Statistic	3708	3784
Mean	Statistic	86.23	82.26

	Std. Error	1.368	1.610
Std. Deviation	Statistic	8.973	10.917
Variance	Statistic	80.516	119.175
Skewness	Statistic	-.207	-.861
	Std. Error	.361	.350
Kurtosis	Statistic	-.919	.922
	Std. Error	.709	.688
CV	Statistic	10.41	13.27

Based on Table 1 regarding the SPSS Descriptive Statistics output, the following conclusions are obtained:

Based on the mean, the average numeracy skills score for students learning with mathematics in context is 86.23, which is higher than the average score for students learning with a flipped classroom (82.26).

Based on the standard deviation, it can be seen that the data of the standard deviation scores of students' numeracy skills acquisition who learn with flipped classroom learning is 10.917, which is more spread out compared to the data of the scores of students' numeracy skills acquisition who learn with mathematics in context learning, which is 8.973.

Based on the skewness values, the data on students' numeracy skills scores who studied using mathematics in context are negatively skewed, indicating that the numeracy skills scores of these students are clustered at higher levels. Meanwhile, the skewness value for those who studied using the flipped classroom method is -0.861, indicating negative skew, so the numeracy skills scores of students who studied using the flipped classroom method are clustered at higher levels. These results can be illustrated in the following histogram output

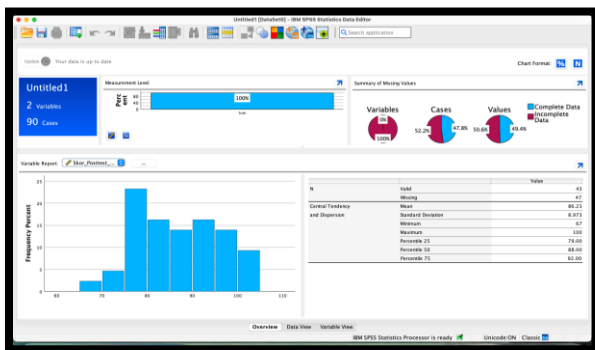


Figure 1: Histogram of Numeracy Skills in Mathematics in Context Learning

Based on Figure 1, the graph of students' numeracy scores for those who learn mathematics in context tends to be negatively sloped. The figure also shows that numeracy scores tend to cluster at higher levels among students who learn through mathematics in context

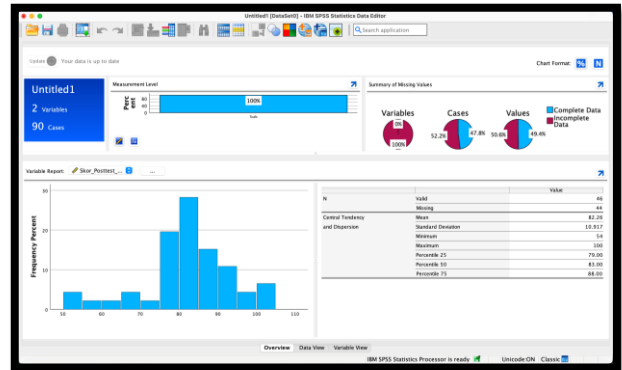


Figure 2: Histogram of Numeracy Skills in Mathematics in Flipped Classroom Learning

Based on Figure 2, the distribution of students' numeracy scores for those who learn with the flipped classroom tends to be negatively skewed. The figure also shows that numeracy scores tend to cluster at higher levels among students who learn using the flipped classroom method.

To answer research question 2, which examines the influence of mathematics in context learning on students' numeracy abilities, the researcher conducted a hypothesis test using end-of-test score data (posttest scores). The answer to this question depends on whether the hypothesis stating that 'mathematics in context learning has a significant effect on students' numeracy achievement' is rejected or accepted, which, formally, the statistical hypothesis (H_0) and the research hypothesis (H_1) are as follows:

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \leq \mu_2$$

Note:

μ_1 is the average pretest score of the population of students who study using mathematics in context learning.

μ_2 is the average posttest score of the population of students who have studied using mathematics in context learning.

To test this hypothesis, the assistance of SPSS version 31 software was used in relation to 'Compare Means (Paired Sample T-Test)', and the output is as follows:

Table 2: Output of Paired Sample t-Test Results of Students' Numeracy Skills in Mathematics in Context Learning.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posttest_Score_Numeracy Skills_Mathematics in Context	86.23	43	8.973	1.368
	Pretest_Score_Numeracy Skills_Mathematics in Context	45.95	43	9.666	1.474

Table 3: Output of Paired Samples Correlations of Students' Numeracy Skills in Mathematics in Context Learning.

Paired Samples Correlations					
		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Posttest_Score_Numeracy Skills_Mathematics in Context & Pretest_Score_Numeracy Skills_Mathematics in Context.	43	.581	<.001	<.001

Table 4: Output of Paired Samples Statistics Results of Students' Numeracy Skills in Mathematics in Context Learning.

Paired Samples Test										
		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Posttest_Score_Numeracy Skills_Mathematics in Context - Pretest_Score_Numeracy Skills_Mathematics in Context.	40.279	8.550	1.304	37.648	42.911	30.890	42	<.001	<.001

Table 5: Output of Paired Samples Effect Sizes Results of Students' Numeracy Skills in Mathematics in Context Learning.

Paired Samples Effect Sizes						
		Cohen's d	Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Posttest_Score_Numeracy Skills_Mathematics in Context - Pretest_Score_Numeracy Skills_Mathematics in Context.		8.550	4.711	3.660	5.755
		Hedges' correction	8.707	4.626	3.595	5.651

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Based on Table 2 – Table 5 regarding the SPSS Paired

Sample t-Test output, the following conclusions were obtained:

Based on the one-sided p significance value in

Paired Samples Correlations, a significance value of <0.001 was obtained, which is smaller than the significance level of 0.05 (α). This indicates a significant positive correlation between pretest and posttest

scores for students' numeracy abilities who learn mathematics in context. The correlation coefficient $r = 0.581$ falls in the high range, indicating that the relationship between initial scores (pretest) and final scores (posttest) is quite meaningful. The coefficient of determination value (r^2) = $(0.581)^2 = 0.337$, which

means that variations in pretest scores can explain 33.7% of the variation in posttest scores. Thus, pretest scores positively affect students' numeracy skills in posttest scores when learning mathematics in context.

Based on the one-sided p-value in the paired-samples test, a significance value of < 0.001 was obtained, which is smaller than the significance level of 0.05 (α). This indicates that H_0 is rejected and H_1 is accepted, so it can be concluded that mathematics in context learning significantly affects students' numeracy skills. Thus, there is a significant difference between pretest and posttest scores of numeracy skills after students receive mathematics in context learning.

Based on the one-sided p-value in the paired-samples effect sizes, a Cohen’s d value of 85.550 with a point estimate of 4.711 > 0.80 (large) was obtained, indicating that the effect of mathematics in context learning on students’ numeracy skill acquisition falls into the high category.

To answer research question 3, which examines the effect of flipped classroom learning on students’ numeracy skills, the researcher conducted a hypothesis test using students’ final test scores (posttest scores) on numeracy. The answer to this question depends on whether the hypothesis stating that ‘flipped classroom learning has a significant effect on students’ numeracy achievement’ is rejected or accepted, which, formally, the statistical

hypothesis (H₀) and the research hypothesis (H₁) are as follows:

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \leq \mu_2$$

Note:

μ_1 is the average pretest score of the population of students who study using flipped classroom learning.

μ_2 is the average posttest score of the population of students who have studied using flipped classroom learning.

To test this hypothesis, the assistance of SPSS version 31 software was used in relation to ‘Compare Means (Paired Sample T-Test)’, and the output is as follows:

Table 6: Output of Paired Sample t-Test of Students’ Numeracy Skills in Flipped Classroom Learning.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posttest Score of Numeracy Skills_Flipped Classroom	82.26	46	10.917	1.610
	Pretest_Score_Numeracy Skills_Flipped Classroom	53.80	46	12.110	1.786

Table 7: Output of Paired Samples Correlations of Students’ Numeracy Skills in Flipped Classroom Learning.

Paired Samples Correlations					
		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Posttest Score of Numeracy Skills_Flipped Classroom & Pretest Score of Numeracy Skills_Flipped Classroom	46	.700	<.001	<.001

Table 8: Output of Paired Samples Test of Students’ Numeracy Skills in Flipped Classroom Learning.

Paired Samples Test										
		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Posttest Score of Numeracy Skills_Flipped Classroom - Pretest Score of Numeracy Skills_Flipped Classroom	28.457	8.986	1.325	25.788	31.125	21.479	45	<.001	<.001

Table 9: Output of Paired Samples Effect Size of Students’ Numeracy Skills in Flipped Classroom Learning.

Paired Samples Effect Sizes						
		Standardizer ^a	Point Estimate	95% Confidence Interval		
				Lower	Upper	
Pair 1	Posttest_Score_Numeracy Skills_Flipped Classroom - Pretest_Score_Numeracy Skills_Flipped Classroom	Cohen’s d	8.986	3.167	2.450	3.877
		Hedges’ correction	9.139	3.114	2.409	3.812

a. The denominator used in estimating the effect sizes.

Cohen’s d uses the sample standard deviation of the mean difference.

Hedges’ correction uses the sample standard deviation of the mean difference, plus a correction factor.

Based on Table 6 - Table 9 regarding the SPSS Paired Sample t-Test output, the following conclusions were obtained:

Based on the significance value of the one-sided p-value in paired-samples correlations, a significance value of < 0.001 was obtained, which is smaller than the significance level of 0.05 (α). This indicates a

significant positive correlation between pretest and posttest scores for students' numeracy skills who learn in a flipped classroom. The correlation coefficient $r = 0.700$ falls in the high range, indicating that the relationship between initial (pretest) and final (posttest) scores is quite meaningful. The coefficient of determination ($r^2 = (0.7)^2 = 0.49$), which means that the variation in pretest scores can explain 49% of the variation in posttest scores. Thus, pretest scores positively affect students' posttest numeracy scores in a flipped classroom.

Based on the one-sided p significance value in the Paired Samples Test, a significance value of < 0.001 was obtained, which is smaller than the significance level of 0.05 (α). This indicates that H_0 is rejected and H_1 is accepted, so it can be concluded that flipped classroom learning has a significant effect on students' numeracy skills. Thus, there is a significant difference between the pretest and posttest scores in numeracy skills after students receive flipped classroom learning.

Based on the one-sided p -value in paired-samples effect sizes, a Cohen's d value of 8.986 was obtained, with a point estimate of $3.167 > 0.80$ (large), indicating that the effect of flipped classroom learning on students' numeracy skills falls into the high (large) category.

The answers to research questions number 4, 5, and 6 are highly dependent on whether the following three hypotheses are rejected or accepted:

There is a difference in the effect of mathematics in context learning and flipped classroom learning on students' acquisition of numeracy skills.

There is a difference in the influence of students' level of mathematical resilience on students' numeracy achievement.

There is an interaction effect between the learning model and students' mathematical resilience on students' numeracy achievement

Formally, the statistical hypothesis (H_0) and the research hypothesis (H_1) are as follows:

$$H_0 : \alpha_1 = \alpha_2$$

$$H_1 : \alpha_1 \neq \alpha_2$$

$$H_0 : \beta_1 = \beta_2 = \beta_3$$

$$H_1 : \text{not } H_0$$

$$H_0 : \alpha_1 \beta_1 = \alpha_1 \beta_2 = \alpha_1 \beta_3 = \alpha_2 \beta_1 = \alpha_2 \beta_2 = \alpha_2 \beta_3$$

$$H_1 : \alpha_1 \beta_j \neq 0$$

Note:

α_1 = Learning mathematics in context

α_2 = Flipped classroom learning

β_1 = High level of mathematical resilience

β_2 = Medium level of mathematical resilience

β_3 = Low level of mathematical resilience

To test the three hypotheses above (Hypotheses 4, 5, and 6), the researcher used SPSS version 31 to run a two-way ANOVA using the general linear model. The output is shown in Table 10 for the General Linear Model (Two-Way ANOVA) of students' numeracy scores by learning and level of mathematical resilience.

Table 10: Output of the General Linear Model (Two-Way ANOVA) Student Numeracy Skills Score based on Mathematics in Context learning with flipped classroom and Level of Mathematical Resilience.

Tests of Between-Subjects Effects					
Dependent Variable: Numeracy Skills Score					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4416.472 ^a	5	883.294	15.670	<.001
Intercept	631275.545	1	631275.545	11198.925	<.001
Learning	383.373	1	383.373	6.801	.011
Mathematical Resilience Level	3936.257	2	1968.128	34.915	<.001
Learning * Mathematical Resilience Level	122.074	2	61.037	1.083	.343
Error	4678.652	83	56.369		
Total	639770.000	89			
Corrected Total	9095.124	88			

a. R Squared = .486 (Adjusted R Squared = .455)

Based on Table 10 regarding the SPSS output of the Test of Between-Subject Effects, the following conclusions were obtained:

The Sig value in the corrected model is < 0.001 , and this value is smaller than 0.05 (α), so it is concluded that the analysis model used in this study is valid.

The Sig value at the intercept is < 0.001 , and this value is smaller than 0.05 (α), so it is concluded that

the change in the dependent variable is significantly independent of the independent variable.

The Sig value in learning is 0.011 , and this value is smaller than 0.05 (α), it is concluded that there is a difference in the effect of mathematics in context learning and flipped classroom learning on students' numeracy skills. Based on the average numeracy Skills of those who learned with mathematics in context (86.23), these are higher than those of those

who learned with the flipped classroom (82.26). Therefore, context-based mathematics learning has a greater impact than flipped classroom learning.

The Sig value at the level of mathematical resilience is <0.001 , and this value is smaller than 0.05 (α), so it is concluded that there is a difference in the effect of the level of resilience on the acquisition of numeracy skills.

The Sig value for the interaction between learning and mathematical resilience level is 0.343 , which is greater than 0.05 (α), so it is concluded that there is no interaction effect between learning and mathematical resilience level on the acquisition of numeracy skills.

There is a correlation between learning and mathematical resilience, along with numeracy skills, with a correlation coefficient of 0.7 , indicating that $r^2 = 0.486$, or 48.6% of students' numeracy skills are

jointly influenced by learning and the level of mathematical resilience.

Based on the results of the Two-Way ANOVA in Table 10, the learning models and levels of mathematical resilience factors contribute differently to students' numeracy skills. Although no interaction effect between these two factors was found, the variable-level significance for mathematical resilience indicates a significant difference across categories of mathematical resilience in relation to numeracy scores. Therefore, further analysis is needed to determine which categories differ significantly. The Post Hoc LSD test was then used to identify pairs of mathematical resilience levels that have significantly different average numeracy scores. The results of the Post Hoc test are presented in Table 11

Table 11: Post Hoc LSD Test of the Interaction of Learning \times Mathematical Resilience on Numeracy Scores.

Multiple Comparisons						
Dependent Variable: Score_Numeracy Skills						
LSD						
(I) Interaction	(J) Interaction	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Mathematics in Context-High	Mathematics in Context-Medium	9.000*	2.838	.002	3.36	14.64
	Mathematics in Context-Low	14.481*	2.790	<.001	8.93	20.03
	Flipped Classroom-High	3.548	2.790	.207	-2.00	9.10
	Flipped Classroom-Medium	10.652*	2.748	<.001	5.19	16.12
Mathematics in Context-Medium	Flipped Classroom-Low	21.748*	2.790	<.001	16.20	27.30
	Mathematics in Context-High	-9.000*	2.838	.002	-14.64	-3.36
	Mathematics in Context-Low	5.481	2.790	.053	-.07	11.03
	Flipped Classroom-High	-5.452	2.790	.054	-11.00	.10
Mathematics in Context-Low	Flipped Classroom-Medium	1.652	2.748	.549	-3.81	7.12
	Flipped Classroom-Low	12.748*	2.790	<.001	7.20	18.30
	Mathematics in Context-High	-14.481*	2.790	<.001	-20.03	-8.93
	Mathematics in Context-Medium	-5.481	2.790	.053	-11.03	.07
Flipped Classroom-High	Flipped Classroom-High	-10.933*	2.742	<.001	-16.39	-5.48
	Flipped Classroom-Medium	-3.829	2.698	.160	-9.20	1.54
	Flipped Classroom-Low	7.267*	2.742	.010	1.81	12.72
	Mathematics in Context-High	-3.548	2.790	.207	-9.10	2.00
Flipped Classroom-Medium	Mathematics in Context-S	5.452	2.790	.054	-.10	11.00
	Mathematics in Context-Low	10.933*	2.742	<.001	5.48	16.39
	Flipped Classroom-S	7.104*	2.698	.010	1.74	12.47
	Flipped Classroom-R	18.200*	2.742	<.001	12.75	23.65
Flipped Classroom-Low	Mathematics in Context-High	-10.652*	2.748	<.001	-16.12	-5.19
	Mathematics in Context-Medium	-1.652	2.748	.549	-7.12	3.81
	Mathematics in Context-Low	3.829	2.698	.160	-1.54	9.20
	Flipped Classroom-High	-7.104*	2.698	.010	-12.47	-1.74
Flipped Classroom-Kow	Flipped Classroom-Low	11.096*	2.698	<.001	5.73	16.46
	Mathematics in Context-High	-21.748*	2.790	<.001	-27.30	-16.20
	Mathematics in Context-Medium	-12.748*	2.790	<.001	-18.30	-7.20
	Mathematics in Context-Low	-7.267*	2.742	.010	-12.72	-1.81
	Flipped Classroom-High	-18.200*	2.742	<.001	-23.65	-12.75
	Flipped Classroom-Medium	-11.096*	2.698	<.001	-16.46	-5.73

*. The mean difference is significant at the 0.05 level.

Although the ANOVA results indicated that the interaction between the learning model and the level of mathematical resilience was not significant, the

Post Hoc LSD test revealed patterns of differences in numeracy achievement that remain pedagogically meaningful. The group of students with high

participation in mathematics in context consistently showed the highest numeracy scores and differed significantly from the majority of other groups, whereas the flipped classroom-low mathematical resilience group had the lowest achievement and differed significantly from all other combinations of learning models and mathematical resilience levels. Meanwhile, the group with mathematical resilience tends to be in the middle and shows no significant differences compared with several other groups. This pattern indicates that although formal interaction is not significant, the effectiveness of learning mathematics in context is relatively higher for students with high mathematical resilience. In contrast, flipped classroom learning is less supportive of numeracy achievement for students with low mathematical resilience. Hence, the variation in scores between combinations remains relevant to consider in learning implications.

4 DISCUSSION

The research results show that the numeracy skills of students who participated in mathematics-in-context learning (α_1) are higher than those of students who studied through flipped classroom learning (α_2). The difference in average scores (mathematics in context = 86.23; flipped classroom = 82.26) indicates that the use of authentic contexts in mathematics in context is more effective in helping students build numeracy understanding. Theoretically, this finding aligns with the concept of Realistic Mathematics

Education developed by Freudenthal (1991) and further elaborated by Gravemeijer (1994), which posits that mathematical understanding will be stronger if students start from real-life situations (experiential reality) and gradually undergo a process of progressive mathematization toward formal concepts. This approach is highly relevant to numeracy skills, which, according to NAPLAN (2012) and OECD (2019), require the ability to interpret, represent, and apply mathematical concepts in real-life contexts.

The paired-samples t-test showed that learning mathematics in context resulted in a significant increase from pretest (μ_1) to posttest (μ_2) scores, with a difference of 40.279 points and a very large effect size (Cohen's $d = 4.711$). This indicates that mathematics in context has a strong impact on numeracy improvement, consistent with the theory that authentic contexts promote higher-order thinking and problem-solving. Students not only complete calculations but also understand the problem's structure, choose the appropriate strategy,

and interpret the results. Flipped classroom learning also shows a significant increase ($\Delta = 28.457$; $p < 0.001$) with a large effect size ($d = 3.167$). The flipped classroom model allows students to access pre-class materials via digital media, then use face-to-face sessions to deepen their understanding of concepts. This mechanism aligns with the principle of cognitive pre-training in multimedia learning theory, which presents initial information to reduce cognitive load when students engage in more complex reasoning activities.

The results of the Two-Way ANOVA showed that both the learning model (α_1 vs α_2) and the level of mathematical resilience— β_1 (high), β_2 (medium), and β_3 (low)—had significant effects on numeracy skills (p

< 0.05). The influence of mathematical resilience aligns with the theoretical framework of Kookken et al. (2013), which explains that students with high mathematical values, tolerance for difficulty (struggle), belief that mathematical ability can develop (growth mindset; Dweck, 2012), and the ability to persevere when facing obstacles (resilience; Bandura, 1989) tend to show better numeracy performance. These findings reinforce the idea that numeracy skills are not only cognitive but are also strongly influenced by affective factors and students' self-confidence.

Although the interaction effect between learning model \times mathematical resilience was not significant ($p = 0.343$), the Post Hoc LSD test results showed a pedagogically meaningful pattern. The mathematics-in-context-high mathematical resilience group ($\alpha_1\beta_1$) consistently obtained the highest numeracy scores and was significantly higher than most other groups, whereas the flipped classroom-low mathematical resilience group ($\alpha_2\beta_3$) had the lowest scores. This pattern indicates that mathematics in context is more effective for students with high mathematical resilience, as they can manage the complexity of contextual situations. At the same time, the flipped classroom tends to be less supportive for students with low mathematical resilience who require more intensive scaffolding. Thus, although the interaction is not statistically significant, the practical interaction is evident in the pattern of differences between groups.

The joint contribution analysis, with $R^2 = 0.486$, shows that 48.6% of the variation in numeracy skills is explained by the combination of learning models (α_1, α_2) and levels of mathematical resilience ($\beta_1, \beta_2, \beta_3$). This means that the remaining 51.4% of the variation is influenced by other factors not included in the model. One important factor in this study is the

use of the Smart Numafit digital teaching module, which is employed consistently in both learning models. This digital teaching module is designed according to multimedia design principles (Mayer, 2009), such as text-visual integration, information segmentation, and feedback provision, which have been shown to affect retention and conceptual understanding. Previous research shows that digital modules and e-modules can increase students' motivation, conceptual understanding, and problem-solving abilities (Herlandy & Syahfutra, 2025; Ismail et al., 2025). Therefore, it is very likely that a large part of the 51.4% of the numerical variation not yet explained by learning and mathematical resilience stems from the quality and effectiveness of the digital teaching modules used, the intensity of student use, and their suitability for each student's learning characteristics. Overall, learning mathematics in context has proven superior at improving numeracy skills; mathematical resilience plays a significant role, and the Smart Numafit digital teaching module provides a strong, supportive contribution to students' numeracy achievement. The combination of these three factors shows that strengthening numeracy requires synergy among the appropriate learning model, students' affective characteristics, and well-designed digital learning tools.

5 CONCLUSION

This study shows that there is a significant difference in the influence between mathematics in context learning and the flipped classroom on

students' numeracy skills, as evidenced by a significance value of $p = 0.011$ for the learning factor, where the average numeracy of students in mathematics in context is higher compared to the flipped classroom. In addition, mathematical resilience has a significant effect on numeracy skills ($p < 0.001$), indicating differences in numeracy achievement among students with high, medium, and low levels of mathematical resilience. Meanwhile, the interaction between the learning model and mathematical resilience is not significant ($p = 0.343$), indicating that both factors act independently in influencing numeracy. The model analysis produced $R^2 = 0.486$, indicating that 48.6% of the variation in numeracy skills is explained by learning and mathematical resilience together. In comparison, the remaining 51.4% is influenced by other factors, including the Smart Numafit digital learning module. Thus, the research results strengthen the notion that mathematics-in-context learning and a flipped classroom assisted by Smart Numafit affect numeracy skills, especially when viewed through differences in students' levels of mathematical resilience.

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