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The Impact of Positive Attitude on Motivation, Anxiety, and Mathematical Performance Among Lower Secondary Students in Karachi, Pakistan

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ABSTRACT

This study investigated the motivation, anxiety, and mathematical performance as predictors of students' positive attitude toward learning mathematics. While several challenges influence students' performance, their unfavourable attitude toward mathematics has been recognised as one of the most significant barriers. Using the correlational study, the data was gathered from the students enrolled in grades 6, 7, and 8 from the public and private schools in Karachi, following the Catholic Board of Education Karachi (CBEK). The findings of the study revealed a significant correlation between motivation, anxiety, and the mathematical performance of students. The results offer several implications for educators, school leaders, and curriculum developers. Mathematics teachers must prioritise fostering positive classroom experiences by incorporating interactive teaching strategies, real-life problems, and constructive feedback. Such practices enhance students' attitudes toward mathematics, reduce anxiety and enhance motivation. School management should foster such a climate where mistakes are treated as learning opportunities. Continuous training for mathematics teachers about digital tools and mathematics applications, and simulations must be provided. Curricula must integrate activities such as gamified learning, peer collaboration, and mathematics clubs.

INTRODUCTION

Developing a positive attitude towards mathematics is important to mitigate mathematical anxiety among students. Students who perform better are intrinsically motivated to learn, but some factors like school climate and parental involvement also contribute towards the development of a positive attitude towards the subject (Nayab et al., 2023). Building on this, achieving a better grade in mathematics is especially important for lower secondary and secondary students in Pakistan, as success in the subject leads to admission in better colleges and universities. While performance is one of the fundamental indicators of achievement, motivation and anxiety also serve as vital indicators to measure a student's positive attitude towards learning mathematics.

In this context, understanding mathematics is greatly

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influenced by the attitude students hold toward the subject, since learner achievement is often determined by it. Higher scores are generally achieved by students with a positive attitude toward mathematics compared to those with a negative one. According to Bekele (2019), a good score in mathematics predicts students' positive attitude toward the subject, but it is unlikely that a student has a positive attitude may also get good marks. Some students who show a positive attitude and likeness toward the subject may perform badly. Despite this contradiction, most research worldwide confirms a strong correlation between mathematics performance and students' positive attitude.

Further contributing to this discussion, Hiller et al. (2022) and Bhutta et al. (2025) hold that higher anxiety in mathematics may negatively impact performance. Their study in the Greek context revealed that mathematics anxiety and performance are directly correlated. This comparison is evident in this study as motivation and anxiety are inversely proportional to each other. The importance of this issue in Pakistan becomes evident when considering national assessments.

In Pakistan, students have weak mathematical skills as parents are liberating and subject-specialist are scare, therefore many students fail to perform basic calculations like 2-digit divisions (Nayab et al., 2023). Students develop fear of mathematics because due to inattention escalating anxiety thus lowering mathematical performance. The lead researcher raised the question why so many students perform poorly despite being exposed to formal classroom environment. To address these concerns, the present study investigates motivation, anxiety, and mathematical performance as predictors of students' positive attitude toward learning mathematics. While several challenges influence students' performance, their unfavorable attitude toward mathematics has been recognized as one of the most significant barriers (Simegn & Asfaw, 2018).

This study aims to examine the effect of:

- Positive attitude on students' motivation
- Positive attitude on students' anxiety
- Positive attitude on mathematical performance

Theoretical Underpinnings of the Study

The Constructive Learning Theory (CLT) by Jean Piaget and Socio-Cultural Theory of Cognitive Development (SCT) by Lev Vygotsky have led the foundation stone for this study. CTL holds that learning is constructed through experience gained and understanding developed by students when given a conducive learning environment (experience) and while developing conceptual understanding, students become constructors of knowledge rather than passive receivers of the information gained during the teaching learning process (Ulrich et al., 2014).

The 21st century learners when taught through exploration (discovery learning), problem based learning (PBL), inquiry-based learning (IBL), can make connections and inferences of the mathematical concept (Lethulur et al., 2025). Investigations and discovery via IBL approach, helps students explore mathematical concepts better as this method mirrors the real world mathematical and scientific inquiries by fostering critical thinking, problem solving and coloration skills. Students develop deeper understanding of mathematical rules and application when taught using IBL approach (Sabreen & Prithika, 2025). Thus, CLT encourages teachers to adapt constructivist philosophy and thereby shift their teacher centered classrooms to dynamic learning environments (Sumarna & Gunawan, 2022).

The learning process is called experiential because knowledge and understanding are constructed through active engagement, deeper understanding and effective information retention through hands on experience and reflection (Daniels, 2025). CLT has brought a revolution in mathematics education because it has transformed the way mathematics is approached. The process of learning is based on how students perceive and understand mathematics. CLT emphasize the importance of using cognitive strategies in developing calculation skills, understanding and solving a problem, grasping knowledge, remain actively engaged and learn effectively in classrooms while teachers facilitate the learning process than deliver the content directly.

Interaction with the environment is necessary for the construction of knowledge (Pattiasina et al., 2025). When students encounter a new mathematical concept, they assimilate the information into existing cognitive structures or accommodate the information by modifying their prior understanding

about the concept (Mehrabi & Morphew, 2025). For instance, when learning fractions, students might initially struggle because their whole-number understanding doesn't directly apply. Through hands-on activities with fraction bars or pie charts, they construct new mental models that accommodate fractional thinking.

Communication plays an important role in an inclusive learning environment where students learn in collaboration with each other thus knowledge is constructed when a student learn to assimilate, accommodate and modify schema (Pattiasina et al., 2025). Socio Cultural Theory (SCT) emphasise on the importance collaboration process of learning (Fadzil & Osman, 2025). When students solve a given problem in pairs or a group they get engaged in discourse and reason out to accomplish a challenging task. This social interaction is helpful for the students and improves their critical thinking and develop problem solving skills to solve complex and unseen problem-based questions.

Effect of Positive Attitude on Motivation, Anxiety and Mathematical

Positive Attitude and Motivation

According to Mata et al. (2012), motivation and positive attitude are positively correlated with each other. Studies by Budhiarti et al. (2025), Patsiomitou, (2025) and Zhou et al. (2025) also confirm motivation as a strong predictor for developing a positive attitude among students. Students show willingness to learn mathematics when their perception of mathematics is positive. Supporting this thought, Wangdi (2023) holds that a student's academic performance is determined by students' perception about the subject and a positive attitude is motivational factors to keep students engaged while learning mathematics at different levels at school.

Students remain on task when effectively engaged using innovative teaching methods. An element of fun and communication makes the mathematical content more engaging and students can easily relate the question with their own life when taught using interactive instructional approach. Innovative teaching strategies not only fosters a positive attitude but also boosts confidence and add value towards the subject. Students who demonstrate better understanding tends to remain more positive towards the subject. It is therefore necessary to strengthen teachers' competencies for using motivational strategies by fostering enjoyment in classroom (Wen & Dube, 2022; Sajiman & Hasbullah, 2022).

H_1: Positive attitude (PA) increases students' Motivation (MO)

Positive Attitude and Anxiety

Math anxiety is negatively correlated with positive attitude and mathematical performance (Atoyebi & Atoyebi, 2022). To enhance students' achievement in mathematics and reduce anxiety, it is therefore essential to address the emotional factors influencing learning (Shakmaeva, 2022). Supporting this view, research by Atoyebi and Atoyebi (2022), through a systematic literature review, highlights that the use of technology-enhanced teaching methods in mathematics can help cultivate positive attitudes among lower secondary students, alleviate math anxiety, and improve both confidence and problem-solving skills. In addition, tackling anxiety has been shown to improve attitudes and foster greater engagement and enjoyment in other subjects, such as physical education classes.

While exploring the relationship between students' attitude and anxiety, mathematical anxiety is found closely linked with negative attitude and effect mathematical performance, this result suggest that emotions are central to conceptual development in mathematics therefore learning environments providing emotional support and innovative instructional strategies are essential for developing positive attitude towards learning mathematics (Gunderson et al., 2012).

H_2: Positive attitude (PA) reduces students' Anxiety (AX)

Positive Attitude and Mathematical Performance

A student's better performance in mathematics depends on the attitude towards the subject. Parents and teacher highly contribute in the development of the positive attitude towards the subject. Students who receive a consistent support from parents at home and teachers at school tend to develop a positive attitude in mathematics and perform better therefore mathematical performance is a key indicator for students' attitude towards mathematics. Recent studies further validate the consistency of this relationship. Shakya and Maharjan (2023) found a statistically significant positive correlation between

students' attitudes and their performance in mathematics.

Student's attitude towards mathematics is influenced by internal and external factors (Nayab et al., 2023). Learning environment being an external factor plays a crucial role in shaping students' attitude towards learning mathematics; therefore, a constructive classroom climate is essential for students to improve performance and stay motivated towards learning (Ampadu & Anokye-Poku, 2022). The current era is a time where the digital immigrants are attempting to teach digital natives, therefore it is necessary for teachers to become familiar with the technology at hand to promote constructive learning in class. The digital divide between teachers and students must reduce so that both may constructively apply technology to connect abstract concepts with concrete digital examples.

Manatad and Baluyos (2023) hold that students' satisfaction with innovative teaching strategies and their favourable attitude towards mathematics are strong predictors of academic success. Subia et al. (2018) on the other hand opines that performance is substantially improved by elevated levels of positive attitude, whereas less favourable outcomes are associated with negative attitudes. Furthermore, it was discovered by Oredina et al. (2024) that enhanced competence was exhibited by students who perceived mathematics as enjoyable and engaging, indicating that a direct role is played by enjoyment in mathematical achievement. According to Wakhata et al. (2024), students' competence in mathematics is notably enhanced by the implementation of problem-based learning strategies, which established real-life connections. It is suggested by the findings that enhanced performance in tasks performed in collaboration with peers solving a real-life scenario contributed to an improved attitude in mathematics, especially regarding mathematical word problems, thus underscoring the value of meaningful and contextualized instruction.

Ultimately, the widespread nature of this relationship is emphasized by studies focusing on gender-based assumptions. The prevailing notion that males excel beyond females in mathematics was questioned by Jaen and Baccay (2016). It was indicated by their study that higher levels of curiosity and motivation were demonstrated by female students, whereas comparable attitudes toward mathematics were shown by both genders, with no notable differences in performance observed. It can therefore be concluded that gender and mathematical performance are not correlated and that better scores in mathematics are achieved equally by both male and female students if they are motivated and develop a positive attitude towards the subject. It is therefore hypothesized that:

H_3: Positive attitude (PA) towards learning mathematics enhances Mathematics Performance (MP)

Framework of the Study

Positive Attitude (PA) is presented by the conceptual framework of this study as an independent variable that is influenced directly by three key outcomes: Motivation (MO), Anxiety (AX), and Mathematical Performance (MP). As depicted in the model, it is hypothesized that motivation is positively impacted by PA, anxiety is negatively related to PA, and a direct positive effect on mathematical performance is exerted by PA. This structure is grounded in empirical evidence that suggests it is generally true that students who exhibit a more favourable attitude towards mathematics are more likely to be motivated, experience lower levels of anxiety, and perform better in mathematical tasks.

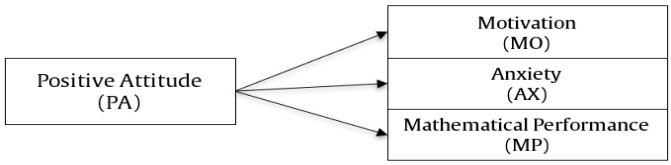

Fig. 1. Framework of the study

METHODOLOGY

This study aims to examine the relationships between positive attitude (PA), motivation (MO), anxiety (AX), and mathematical performance (MP) among lower secondary students. Specifically, the study investigates how students' positive attitudes toward mathematics influence their motivation and anxiety levels, and how these variables are associated with their performance in mathematics. The data was gathered from Grade 6-9 students enrolled of Catholic Board of Education Karachi (CBEK) schools. These schools were purposefully selected due to the similarity in students' socio-economic backgrounds and

the availability of computer labs with stable internet access, ensuring smooth digital data collection. Additionally, one public school with the required computer facilities and students from Grades 6 to 9 was included.

The research design was correlational which assessed the direct relationships among the four latent variables. After obtaining formal approval from the school heads, data were collected through a student survey. Out of 602 responses received, one was excluded due to non-engagement. Following the removal of 47 multivariate outliers using a 99.99% confidence interval ($p < .001$) in line. The final dataset consisted of 554 valid responses, achieving a 92% response rate.

Table 1

Demographic Profile (n=554)

Demographic	Description	Count	%
Gender	Male	303	54.7
	Female	251	45.3
Grade Level	6	154	27.8
	7	129	23.3
	8	115	20.8
	9	156	28.2
Sector	Public	223	40.3
	Private	331	59.7
Mathematics Achievement Test	50% to 60%	161	29.1
	61% to 70%	107	19.3
	71% to 80%	120	21.7
	81% to 90%	91	16.4
	91% to 100%	70	12.6
	Less than 50%	5	0.9

Measure

To measure the four latent variables outlined in the study framework, a questionnaire with 5-points Likert Scale, comprised of 23 items was adapted from previous validated instruments. Specifically, 5 items assessed students' motivation, 5 items measured positive attitude toward mathematics, 5 items were designed to capture mathematics-related anxiety and 8 items evaluated mathematical performance. The overall internal consistency of the scale was found to be $\alpha = 0.810$, exceeding the acceptable threshold of 0.70 (Hair et al., 2019), indicating a high level of reliability.

Data Analysis

The proposed conceptual model is to be examined and validated as the primary aim of this study. To achieve this, data analysis was carried out using a combination of statistical techniques. Initially, data screening was performed using SPSS 22 to ensure accuracy and reliability. Following this, SmartPLS 4 was employed for hypothesis testing and to explore the structural relationships within the model. The analysis in SmartPLS 4 followed a three-step process: (1) constructing the model, (2) evaluating the outer measurement model for reliability and validity of the indicators, and (3) assessing the inner structural model to establish the relationships among the latent variables.

Measurement Assessment Model

Table 2 summarize the reliability results, all variables demonstrated composite reliability values above the acceptable threshold of 0.70, as recommended by Hair et al. (2019), indicating satisfactory internal consistency across the constructs.

Reliability Testing

Composite reliability (CR) was used as a more robust indicator than Cronbach's alpha, as recommended by Hair et al. (2019). The results of Composite Reliability (CR) are presented in Table 2. All constructs demonstrated satisfactory reliability, with CR values ranging between 0.817 (Motivation) and 0.878 (Mathematical Performance), well above the recommended threshold of 0.70. This indicates that the measurement items for each construct are consistent and reliable. Furthermore, none of the CR values

exceeded 0.95, suggesting the absence of redundancy among the indicators. Thus, the measurement model satisfies the internal consistency reliability criterion.

Table 2

Testing Reliability and Convergent Validity

Constructs	Items	Loadings	p-values	CR	AVE
Positive Attitude	PA1	0.806	0.000	0.875	0.585
	PA2	0.814	0.000		
	PA3	0.748	0.000		
	PA4	0.706	0.000		
	PA5	0.744	0.000		
Motivation	MO1	0.741	0.000	0.817	0.527
	MO2	0.730	0.000		
	MO3	0.750	0.000		
	MO4	0.682	0.000		
Anxiety	AX2	0.722	0.000	0.835	0.5559
	AX3	0.783	0.000		
	AX4	0.703	0.000		
	AX5	0.780	0.000		
Mathematical Performance	MP1	0.710	0.000	0.878	0.507
	MP2	0.734	0.000		
	MP3	0.727	0.000		
	MP4	0.727	0.000		
	MP5	0.689	0.000		
	MP6	0.722	0.000		
	MP7	0.671	0.000		

Notes: CR= Composite Reliability, AVE= Average Variance Extracted

Convergent Validity

The Average Variance Extracted (AVE) was used to assess convergent validity- the extent to which the variance of its indicators is explained by a construct (Hair et al., 2019). A construct is said to have an adequate convergent validity if its AVE exceeds 0.50 and item factor loadings are at least 0.70 (Hair et al., 2019). It was found that the AVE values for Positive Attitude, Motivation, Anxiety, and Mathematical Performance (as shown in Table 2) ranged between 0.507 and 0.585, thereby establishing satisfactory convergent validity for the measurement model.

Discriminant Validity

The extent to which each construct in a model is distinct from the others is referred to by discriminant validity (Hair et al., 2019). In this study, the discriminant validity among the four latent variables, Positive Attitude, Motivation, Anxiety, and Mathematical Performance, was assessed by the researchers using three standard approaches: the Fornell and Larcker criterion, cross-loadings, and the Heterotrait-Monotrait Ratio $(HTMT)_{0.85}$. According to the Fornell and Larcker criterion, the square root of each construct's AVE be greater than its correlations with other constructs, a condition that was satisfied, as is clearly presented in Table 4 (Fornell & Larcker, 1981). Furthermore, it was found that the HTMT values for all paired constructs were below the threshold of 0.90, which confirms the presence of adequate discriminant validity.

Table 3

Discriminant Validity using Fornell and Larcker Criterion

Constructs	PA	MO	AX	MP
PA	0.740			
MO	.521**	0.698		
AX	-.174**	-.086*	0.731	
MP	.651**	.472**	-.170**	0.696

Note: PA= Positive Attitude, MO= Motivation, AX = Anxiety, MP = Mathematical Performance
***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Table 4 presents the HTMT analysis results, which confirm the presence of discriminant validity among the latent variables: Positive Attitude, Motivation, Anxiety, and Mathematical Performance. All HTMT values were observed to fall below the recommended threshold of 0.90, indicating that the constructs are empirically distinct. Additionally, further support for discriminant validity was provided through the examination of cross-loadings, which revealed that each item was loaded more strongly on its respective construct than on others. As recommended by Gefen et al. (2000), the maintenance of a minimum difference of 0.1 was ensured between an item's loading on its own construct and its loading on other constructs, which further served to validate the distinctiveness of the measured variables.

Table 4

Discriminant Validity using $HTMT_{0.85}$

	PA	MO	AX	MP
PA	1			
MO	0.691	1		
AX	0.226	0.151	1	
MP	0.786	0.616	0.230	1

Note: PA= Positive Attitude, MO= Motivation, AX = Anxiety, MP = Mathematical Performance

The $HTMT_{0.85}$ criterion (Table 4) was applied to assess discriminant validity. All HTMT values were below the conservative threshold of 0.85, confirming that each construct was empirically distinct from the others. The highest HTMT value (0.786) was between Positive Attitude (PA) and Mathematical Performance (MP), suggesting a strong relationship but still within acceptable limits. These results support adequate discriminant validity of the measurement model.

Hypothesis Testing

After assessing the outer model measurement, the internal model measurement was evaluated using the variance-based structural equation modelling (PLS-SEM) approach, following the guidelines of Hair et al. (2019). To test the hypothesized relationships among the latent variables, the bootstrapping method with 5000 subsamples was employed, as recommended by Haenlein and Kaplan (2004). Table 5 shows the critical role of positive attitudes in enhancing Motivation (β=0.585, t-value=16.78), reducing Anxiety (β=-0.201, t-value=-3.89), and improving Mathematical Performance (β=0.563, t-value=20.49) respectively, therefore all three hypotheses were statistically supported.

Table 5

Hypothesis Testing of Variables

No	Hypothesis	Estimates	SE	t-value	p-value	Decision
1	PA→MO	0.585	0.035	16.78	<0.001	Supported
2	PA→AX	-0.201	0.052	-3.89	<0.001	Supported
3	PA→MP	0.563	0.027	20.49	<0.001	Supported

Note: SE= Standard Error, PA: Positive Attitude, MO: Motivation, AX: Anxiety and MP: Mathematical Performance

Model Assessment Criteria

According to Hair et al., (2019), accurate prediction of independent variables depends on the model fitness of the measurement model. The coefficient of determination (R^2) measures the model's predictive accuracy on three levels: low (0.3), moderate (0.3-0.6) and high (>0.6), it also represents the overall impact of independent and dependent variables. The value of R^2 = .501, and Adjusted R^2 = .498 in Table 6 indicate that 50.1 % of variance in positive attitude can be explained by the combined predictors.

Table 6

Model Assessment Criteria

Constructs	R^2	Adjusted R^2
MO	.319	.318
AX	.157	.023
MP	.412	.411
Overall	.501	.498

Note: a Predictor: (PA)

Discussion

The present study investigated the effect of Positive Attitude (PA) on students' Motivation (MO), Anxiety (AX), and Mathematical Performance (MP) among public and private lower secondary students in Karachi. It is demonstrated by the findings that a significant and positive influence is exerted on Motivation (MO) and Mathematical Performance (MP) by Positive Attitude (PA), while Anxiety (AX) is negatively affected by it. It is confirmed by these results that a positive attitude towards mathematics keeps students more motivated, less anxious, and ultimately allows them to perform better in mathematics. This perception of the students identified the need to foster a constructive learning environment in mathematics classrooms that will keep them motivated towards the tasks.

The first hypothesis (H_1) stated was supported and aligned with Simegn and Asfaw (2018) who confirmed the interconnectedness between attitude and motivation. Students' motivation is strongly correlated with belief about the subject. This study also identified that students with positive attitude towards mathematics are more motivated to learn. The second hypothesis (H_2) supported the view of Hiller et al. (2022), who believed that students with a positive mathematical attitude does not tend to get nervous. A students become anxious when he develops a negative perception about mathematics being one of the hardest, dull and boring subjects (Mensah et al., 2024). The perception can only be diminished with the use of innovative pedagogies that will help students develop self-confidence and reduce the fear of mathematics. The findings were aligned with Hiller et al. (2022) who believed positive attitude as an important factor to reduce stress in mathematics.

Hypothesis (H_3) supports earlier work by Middleton and Spanias (1999), who concluded that a student's attitude directly influences persistence and achievement. The current results also strengthen the argument presented by Nayab et al., (2023), which demonstrated the role of positive affective variables (attitude and motivation) in boosting mathematical proficiency. In the CBEK (Catholic Board of Education Karachi) context, where students share similar socioeconomic backgrounds, the findings suggest that attitude becomes a particularly decisive factor for academic success in mathematics. Overall, the study highlights the pivotal role of positive attitude as a predictor of cognitive and affective outcomes in mathematics. By boosting motivation, lowering anxiety and improving mathematical performance, whereas positive attitude emerges as a comprehensive determinant of student success.

CONCLUSION

This study contributes to the growing body of literature on mathematics education by establishing the central role of positive attitude in shaping both affective (motivation, anxiety) and cognitive (performance) outcomes. Grounded in Self-Determination Theory, the findings validate that positive attitudes provide the necessary psychological environment for fulfilling students' needs for competence and autonomy. Furthermore, the study extends the theoretical discourse on mathematics anxiety by demonstrating that optimistic attitude functions as a protective factor against anxiety, and a determinant of enhancing performance.

Implications for Educators, School Leaders and Curriculum Developers

The results offer several implications for educators, school leaders, and curriculum developers. Mathematics teachers must prioritize fostering positive classroom experiences by incorporating interactive teaching strategies, real-life problems, and constructive feedback. Such practices enhance students' attitudes toward mathematics, reduce anxiety and enhance motivation. School management should foster such a climate where mistakes are treated as learning opportunities. Continuous training for mathematics teachers about digital tools and mathematics applications and simulations must be provided. Curricula must integrate activities such as gamified learning, peer collaboration, and mathematics clubs. These interventions will create long-term improvements in motivation and performance.

Limitation and Direction for Future Studies

Although the findings offer valuable insights, the study has certain limitations. First, the research was conducted exclusively within CBEK schools and one public school in Karachi, which may limit the generalizability of results to other educational settings in Pakistan. Second, data collection was based on

students' self-reported perceptions, which may be influenced by response bias. Third, the cross-sectional nature of the data restricts causal inferences regarding the long-term relationship between Positive Attitudes (PA), Motivation (MO), Anxiety (AX), and Mathematical Performance (MP).

It is recommended that future research must address these limitations by:

- Expanding the sample to include diverse school systems across Pakistan for greater generalizability.
- Incorporating longitudinal designs to capture how positive attitude influences motivation, anxiety, and performance over time.
- Including qualitative approaches (e.g., interviews, classroom observations) to complement quantitative findings and gain deeper insights into student experiences.
- Examining other affective constructs such as self-confidence, enjoyment, and work-effort to provide a more holistic understanding of positive attitude towards learning mathematics.

Competing Interests

The authors declared no competing interests.

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