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Students' Engagement in Learning Mathematics: Influence on Students' Achievement at Secondary Level in District Lahore

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ABSTRACT

Students' engagement in learning mathematics is crucial for enhancing problem-solving skills and fostering a deep understanding of mathematical concepts. Higher engagement levels are often linked to improved academic achievement, as students become more motivated and persistent in tackling complex mathematical tasks. The objective of the study were to find out the level of students' engagement in learning mathematics, effect and relationship between students' learning engagement and mathematical achievement. Population was comprised of all public male and female schools of grade IX. Multistage sampling techniques was used to select the sample. Questionnaires were used to collect the data. SPSS was used to analyze the data. Descriptive and inferential statistics was used. The findings of the study revealed that there was a significant relationship between students' engagement (cognitive, social, emotional) and mathematical achievement. This study suggested that future research should explore the impact of integrating technology and interactive learning tools on student engagement and achievement in mathematics. Additionally, investigating personalized learning strategies that cater to diverse student needs could further enhance mathematical performance at the secondary level.

Keywords: Students' engagement, social engagement, emotional engagement, cognitive engagement, learning mathematics, students' achievement, secondary level, district Lahore

Introduction

Engagement in learning is a critical factor that directly influences students' academic achievement, particularly in mathematics. As a subject often perceived as challenging, fostering engagement in mathematics is essential for improving students' understanding, performance, and overall achievement. Students' engagement is a multifaceted concept that includes behavioral, emotional, and cognitive components, all of which play a significant role in shaping their academic success (Joshi, Adhikari, Khanal, Khadka, & Belbase, 2022). Behavioral engagement refers to students' active participation in learning activities, such as attending classes, completing assignments, and participating in discussions. In mathematics, behavioral engagement might be demonstrated through regular practice of mathematical problems, active involvement in group work, or the completion of homework (Martin, & Rimm-Kaufman, 2015). Research shows that students who regularly participate in mathematical tasks and demonstrate persistence in problem-solving tend to achieve higher outcomes. This type of engagement often reflects a student's effort and diligence, which are necessary for mastering complex mathematical concepts. Teachers can enhance behavioral engagement by providing clear instructions, offering constructive feedback, and creating an environment where students feel encouraged to take risks and learn from mistakes (Hong, Zhen, Liu, Wang, Ding, & Wang, 2020).

According to Kong, Wong, & Lam, (2003), emotional engagement pertains to students' feelings toward the subject matter, their teachers, and the learning environment. In mathematics, students who feel confident and motivated tend to exhibit higher levels of emotional engagement, leading to better achievement. A positive emotional connection to mathematics can be fostered by creating supportive classroom environments that reduce anxiety and build self-efficacy. Teachers can influence emotional engagement by using praise and

encouragement to boost students' confidence, especially when dealing with difficult topics (Rimm-Kaufman, Baroody, Larsen, Curby, & Abry, 2015). Moreover, providing relevant and real-world applications of mathematical concepts can enhance students' interest and motivation, which are key drivers of emotional engagement. When students perceive mathematics as meaningful and applicable, they are more likely to invest effort and develop a positive attitude toward learning (Goldin, 2014).

Abd Wahid, & Shahrill, 2014) suggested that cognitive engagement refers to the extent to which students are willing to invest mental effort in understanding and mastering challenging concepts. In mathematics, cognitive engagement involves students' ability to think critically, solve complex problems, and apply mathematical reasoning (Sen, 2022). High levels of cognitive engagement are associated with deep learning and greater academic achievement. Students who are cognitively engaged often demonstrate curiosity and a desire to explore mathematical concepts beyond surface-level understanding. Teachers can promote cognitive engagement by designing tasks that require critical thinking and problem-solving, encouraging students to explain their reasoning, and providing opportunities for inquiry-based learning. Incorporating collaborative learning activities, such as group problem-solving and peer discussions, also fosters cognitive engagement by encouraging students to think critically and learn from one another (Lo, & Hew, 2021).

The relationship between engagement and mathematics achievement is well-documented in educational research. Students who exhibit high levels of engagement, across behavioral, emotional, and cognitive domains, consistently outperform their less-engaged peers (Cevikbas, & Kaiser, 2022). This positive correlation can be attributed to the fact that engaged students are more likely to embrace challenges, persevere through difficulties, and employ effective learning strategies. Additionally, engagement promotes a growth mindset, where students view effort as key to success, further enhancing their academic performance. Conversely, disengagement, often characterized by boredom, frustration, or lack of motivation, can lead to lower achievement and a negative attitude toward mathematics (Baroody, Rimm-Kaufman, Larsen, & Curby, 2016).

To improve students' engagement in mathematics, educators must adopt a holistic approach that addresses the various dimensions of engagement. This involves creating learning environments that support active participation, emotional connection, and cognitive stimulation. Effective instructional strategies, such as differentiated instruction, formative assessments, and the integration of technology, can also enhance engagement by catering to diverse learning needs and interests. By prioritizing engagement, teachers can not only improve students' mathematical achievement but also foster a lifelong appreciation for the subject (Yang, Yuan, Tan, Wang, & Li, 2021).

In addition to fostering engagement through behavioral, emotional, and cognitive domains, it is essential to consider the role of the learning environment and the instructional strategies employed in mathematics classrooms. A supportive and stimulating environment can significantly enhance students' motivation to engage with mathematical concepts (Watt, Carmichael, & Callingham, 2017). For example, classrooms that encourage collaboration and problem-solving, rather than focusing solely on individual achievement, allow students to explore diverse perspectives and solutions. Group work, peer tutoring, and cooperative learning not only increase students' active participation but also create a sense of belonging and shared responsibility for learning. These collaborative structures help reduce feelings of isolation or frustration that may arise when tackling complex mathematical problems individually (Goldin, Epstein, Schorr, & Warner, 2011).

Moreover, incorporating real-world applications of mathematical concepts can further boost engagement and achievement. When students can see the relevance of mathematics in their daily lives or in potential future careers, they are more likely to view the subject as meaningful and worthy of effort. Connecting mathematical problems to real-world situations, such as financial literacy, engineering, technology, or environmental issues, demonstrates the utility of mathematics beyond the classroom (Maamin, Maat, & H. Iksan, 2021). These connections make learning more engaging and help students understand the practical value of the abstract concepts they are studying. Project-based learning (PBL) and interdisciplinary approaches that combine mathematics with science, technology, or engineering tasks provide dynamic opportunities for students to apply mathematical reasoning in real-life scenarios. Another factor influencing students' engagement and subsequent achievement in mathematics is the quality of feedback provided by educators. Timely and constructive feedback allows students to understand their strengths and areas for improvement, fostering a growth mindset. When teachers emphasize effort and improvement over inherent ability, students are more likely to persist through challenging tasks and develop resilience in learning mathematics. Formative assessments, in particular, play a crucial role in sustaining engagement. These assessments provide opportunities for students to reflect on their learning progress and make adjustments as needed, promoting a continuous cycle of improvement and deeper understanding of mathematical concepts (Lin, Wang, & Yang, 2018).

Statement of Problem

The significance of teaching and studying mathematics cannot be overstated (Dundar, Beteille, Riboud, & Deolalikar, 2014). Studying mathematics also has a significant impact on a nation's ability to grow economically. At the secondary level, student achievement in mathematics learning is influenced by their level of engagement. The objective of the current study is to examine the relationship between students' engagement and students' achievement. Building logical thought and mental discipline is made simple and successful by

having a solid foundation in mathematics. Additionally, abilities and knowledge of facts and statistics play a crucial part in understanding other academic topics including the sciences and social sciences. It also helps countries to maintain their economic stability or industry leadership. This study will suggest policy makers to formulate such curriculum that will help students to improve their engagement in mathematics. This will also recommend teachers and heads of institutes to promote such activities and implement them that stimulate student's involvement or engagement. This study helps teachers to understand different levels of student's engagement in and helps students to be more encouraged and involved in learning of Mathematics. Students' engagement helps teachers to recognize and refine the achievement of weak students and low-performing and failure students. Moreover, students' engagement within the school premisis and the aim of classroom activities is to increase student's participation. Student's involvement is much important to predict the student's achievement.

Objectives of the study

1. To find the level of students' engagement at secondary level in district Lahore.
2. To explore the correlation between students 'engagement and their Mathematical achievement at secondary level in district Lahore.
3. To inquire the effect of students' engagement on their mathematical achievement at secondary level in district Lahore

Research Design and Methodology

In this study, the researcher used a quantitative methodology. The relationship between students' engagement in learning mathematics and their achievement was investigated using a relationship studies design from the population of grade IX at secondary level in public sector in district Lahore. Population of the study was 59426 enrolled students of 9th grade from 408 (184=male/224=female) public high schools of district Lahore. A multistage sampling technique was employed to gather samples for the investigation. Initially whole population of 9th graders of district Lahore were classified into two strata (male/female) by using stratified sampling technique. The population was divided into five clusters on the basis of tehsils by cluster sampling technique. Simple random sampling technique was used to choose the schools from each cluster. The number of schools in clusters was taken by proportion. 8 schools were selected from Model town, 4 from Cantt , 16 from City,4 from Raiwind and 8 from Shalimar in ratio of 2:1:4:1:2 respectively. At final stage, the number of students for schools was taken in the ratio of 120:60:240:60:120 respectively. Students' engagement questionnaire was adapted by (Batool, 2018), that was consisting of three components of student engagement (cognitive, emotional and social). Mathematical achievement of students' questionnaire was developed by researcher. Validity of the instruments were found through experts' opinions and reliability through pilot testing. The Cronbach's Alpha value of students' engagement 0.863 and Mathematical achievement 0.941. Data collected from the study was examined with the SPSS version 23. There were two types of statistics used: descriptive statistics (Mean and SD) and inferential statistics (correlation and regression analysis). Pearson product moment correlation coefficient was used to find the relationship between students' engagement and students' mathematical achievement. Regression analysis was used to find the effect of student's engagement on students' mathematical achievement.

Data Analysis

Table 1: ***Sample description on the basis of mean and standard deviation***

Variables		N	Mean	S.D.
Student's engagement		600	3.6979	.52293
1-	Cognitive	600	3.8707	.64816
2-	Social	600	3.8264	.69891
3-	Emotional	600	3.4738	.63548
Mathematics		600	.7513	.21037
1-	Knowledge	600	.7710	.21751
2-	Understanding	600	.7479	.23011
3-	Application	600	.7409	.23067

The above table shows that overall students' (cognitive, social and emotional) engagement and mathematical achievement at secondary level. According to the responses of the respondents, level of respondents is (M=3.69; SD=0.52), level of students cognitive engagement (M=3.87; SD=0.64), level of students social engagement (M=3.82; SD=0.69), and level of students emotional engagement (M=3.47; SD=0.63), student's mathematical achievement according to the responses of the respondents (M= .75; SD=0.21), level of achievement regarding knowledge (M=.77; SD=.21), level of achievement regarding understanding (M=.74; SD=.23) and level of achievement regarding application (M=.77; SD=.23). The overall responses of the respondents reflected toward the level of agreement regarding students' engagement and mathematical achievement.

Cognitive engagement

Table 2: Sample description on the basis of mean and standard deviation

Items	N	Mean	S.D.
I find memorizing formulas is the best way to learn mathematics	600	3.96	1.037
In leaning mathematics, I prefer memorizing all the necessary formulas rather than understanding the principles behind them.	600	3.89	1.144
I think memorizing the facts and a detail of a topic is better than understanding is holistically.	600	3.98	1.150
In mathematics learning, it is very useful to memorize the methods for solving word problems.	600	3.92	1.128
In mathematics learning, I prefer memorizing different methods of solution; this is a very effective way of learning.	600	3.86	1.327
I think the best way of learning mathematics is to memorize facts by repeatedly working on mathematics problems.	600	4.20	1.170
I think memorizing mathematics is more effective than understanding it.	600	3.45	1.269
When I learn mathematics, I would wonder how much the things I have learnt can be applied to real life.	600	4.11	1.156
When I learn new things, I would think about what I have already learnt and try to get a new understanding of what I know.	600	3.77	1.072
When I read mathematics textbook, I would try to pick out those things which should be thoroughly understood rather than just reading the text through	600	3.63	1.307
I would try to connect what I learned in mathematics with what I encounter in real life or in other subjects.	600	3.79	1.165
I would spend out of class time to deepen my understanding of the interesting aspects of mathematics	600	3.88	1.232
In learning mathematics, I always try to pose questions to myself and these questions would help me understand the core of mathematics.	600	4.02	1.314
I would use my spare time to study the topics we have discussed in class.	600	3.32	1.518
I really make an effort in the mathematics lesson.	600	4.18	1.151

The above table illustrates the cognitive engagement description. According to the responses of the respondents, I find memorizing formulas is the best way to learn mathematics (M=3.96; SD=1.03), In leaning mathematics, I prefer memorizing all the necessary formulas rather than understanding the principles behind them (M=3.89; SD=1.14), I think memorizing the facts and a detail of a topic is better than understanding is holistically (M=3.98; SD=1.15), In mathematics learning, it is very useful to memorize the methods for solving word problems (M=3.92; SD=1.12), In mathematics learning, I prefer memorizing different methods of solution; this is a very effective way of learning (M=3.86; SD=1.32), I think the best way of learning mathematics is to memorize facts by repeatedly working on mathematics problems (M=4.20; SD=1.17), I think memorizing mathematics is more effective than understanding it (M=3.45; SD=1.26), When I learn mathematics, I would wonder how much the things I have learnt can be applied to real life (M=4.11; SD=1.15), When I learn new things, I would think about what I have already learnt and try to get a new understanding of what I know (M=3.77; SD=1.07), When I read mathematics textbook, I would try to pick out those things which should be thoroughly understood rather than just reading the text through (M=3.63; SD=1.30), I would try to connect what I learned in mathematics with what I encounter in real life or in other subjects (M=3.79; SD=1.16), I would spend out of class time to deepen my understanding of the interesting aspects of mathematics (M=3.88; SD=1.23), In learning mathematics, I always try to pose questions to myself and these questions would help me understand the core of mathematics (M=4.02; SD=1.31), I would use my spare time to study the topics we have discussed in class (M=3.32; SD=1.51), I really make an effort in the mathematics lesson (M=4.18; SD=1.15). Overall, respondents' responses reflected toward the level of agreement.

Social engagement

Table 3: Sample description on the basis of mean and standard deviation

Items	N	Mean	S.D.
The best way to learn mathematics is to follow the teacher‘s instructions.	600	4.08	1.043
I concentrate very hard when the teacher introduces new mathematical concepts.	600	3.99	1.080
If I cannot tackle of problem, I would try again later.	600	3.68	1.389
I would learn what the teacher teaches.	600	3.93	1.218
I would learn in the way the teacher instructs me.	600	3.90	1.128

I would solve problems in the same way as the teacher does.	600	3.72	1.122
I solve problems according to what the teacher teaches.	600	3.66	1.076
I listen to the teacher‘s instruction attentively.	600	3.60	1.314
In the mathematics class, I find the mathematics knowledge interesting and mathematics learning enjoyable.	600	3.75	1.192
In the discussion of new topics, I take an active part and raise my points.	600	3.98	1.144
I help classmates to make them understand math lesson.	600	3.73	1.106
I try to solve problems even with the help of classmates during math lesson.	600	3.54	1.057
I voluntarily solve the problems on board after instructions of teachers	600	3.86	1.180
I believe that I get good marks in math test when I have prepared it through discussion with classmates.	600	3.88	1.212
If I am unable to solve a problem I get help of teacher or classmate.	600	4.11	1.178

The above table illustrates the social engagement description. According to the responses of the respondents, The best way to learn mathematics is to follow the teacher‘s instructions (M=4.08; SD=1.04), I concentrate very hard when the teacher introduces new mathematical concepts (M=3.99; SD=1.08), If I cannot tackle of problem, I would try again later (M=3.68; SD=1.38), I would learn what the teacher teaches (M=3.93; SD=1.21), I would learn in the way the teacher instructs me (M=3.90; SD=1.12), I would solve problems in the same way as the teacher does (M=3.72; SD=1.12), I solve problems according to what the teacher teaches (M=3.66; SD=1.07), I listen to the teacher‘s instruction attentively (M=3.60; SD=1.31), In the mathematics class, I find the mathematics knowledge interesting and mathematics learning enjoyable (M=3.75; SD=1.19), In the discussion of new topics, I take an active part and raise my points (M=3.98; SD=1.14), I help classmates to make them understand math lesson (M=3.73; SD=1.10), I try to solve problems even with the help of classmates during math lesson (M=3.54; SD=1.05), I voluntarily solve the problems on board after instructions of teachers (M=3.86; SD=1.18), I believe that I get good marks in math test when I have prepared it through discussion with classmates (M=3.88; SD=1.21), If I am unable to solve a problem I get help of teacher or classmate (M=4.11; SD=1.17). Overall, respondents’ responses reflected toward the level of agreement.

Emotional engagement

Table 4: Sample description on the basis of mean and standard deviation

Items	N	Mean	S.D.
I find mathematics learning pleasurable and I am interested in solving mathematics problems.	600	4.06	1.173
I feel a sense of satisfaction when I do mathematics exercises in class.	600	4.10	1.167
I am always curious to learn new things in mathematics and I find learning mathematics enjoyable.	600	3.96	1.263
I feel excited when we start a new topic in mathematics.	600	3.90	1.154
I am very interested to know how to solve new mathematics problems. Mathematics always gives me pleasure.	600	3.56	1.278
Through mathematics learning is tough, I feel happy when I can finish the task.	600	3.53	1.289
Through mathematics learning is boring, I am happy when I get good results.	600	3.97	1.295
Learning mathematics is tough, but to get good results the effort is worthwhile.	600	3.91	1.236
Learning mathematics is tough, but I am satisfied when I get good results after making an effort.	600	3.80	1.205
Learning mathematic is tough, but I am happy as long as I can get good results.	600	3.82	1.183
Though learning mathematics is tough, I get a sense of satisfaction when I get good results.	600	4.01	1.294
I find myself very nervous during mathematics tests.	600	3.36	1.717
I am worried in mathematics examinations.	600	3.04	1.555
During mathematics examinations. When I come across problem that I cannot comprehend. I will feel very nervous.	600	3.26	1.502
I am always afraid that I will get poor results in mathematics tests	600	3.08	1.656
During mathematics examinations, when I come across problem that I cannot solve. I will feel very anxious.	600	3.18	1.485
I feel uncomfortable when the teacher starts a new topic.	600	2.80	1.516
I am tired of learning a new topic in school.	600	2.91	1.630
I do not like attending mathematics classes.	600	2.68	1.572
I dislike doing mathematics.	600	2.53	1.557

The above table illustrates the social emotional description. According to the responses of the respondents, I find mathematics learning pleasurable and I am interested in solving mathematics problems (M=4.06; SD=1.17), I feel a sense of satisfaction when I do mathematics exercises in class (M=4.10; SD=1.16), I am always curious to learn new things in mathematics and I find learning mathematics enjoyable (M=3.96; SD=1.26), I feel excited when we start a new topic in mathematics (M=3.90; SD=1.15), I am very interested to know how to solve new mathematics problems. Mathematics always gives me pleasure (M=3.56; SD=1.27), through mathematics learning is tough, I feel happy when I can finish the task (M=3.53; SD=1.28), through mathematics learning is boring, I am happy when I get good results (M=3.97; SD=1.19), Learning mathematics is tough, but to get good results the effort is worthwhile (M=3.91; SD=1.23), Learning mathematics is tough, but I am satisfied when I get good results after making an effort (M=3.80; SD=1.20), Learning mathematic is tough, but I am happy as long as I can get good results (M=3.82; SD=1.18), Though learning mathematics is tough, I get a sense of satisfaction when I get good results (M=4.01; SD=1.29), I find myself very nervous during mathematics tests (M=3.36; SD=1.71), I am worried in mathematics examinations (M=3.04; SD=1.55), During mathematics examinations. When I come across problem that I cannot comprehend. I will feel very nervous (M=3.26; SD=1.50), I am always afraid that I will get poor results in mathematics tests (M=3.08; SD=1.65), during mathematics examinations, when I come across problem that I cannot solve. I will feel very anxious (M=3.18; SD=1.48), I feel uncomfortable when the teacher starts a new topic (M=2.80; SD=1.51), I am tired of learning a new topic in school (M=2.91; SD=1.63), I do not like attending mathematics classes (M=2.68; SD=1.57), I dislike doing mathematics (M=2.53; SD=1.55). Overall, respondents' responses reflected toward the level of agreement.

Table 5: ***Relationship between students (cognitive, social, and emotional) engagement and students' mathematical achievement***

		Students engagement	Students' mathematical achievement
Students engagement	Pearson Correlation	.335**	1
	Sig. (2-tailed)		.000
	N	600	600

Correlation is significant at the 0.01 level (2-tailed).

Table shows the results of correlation coefficient that r value between student's overall engagement and mathematical achievement is 0.335 which shows a weak association between the variables. The p value< 0.01 which means that relationship is statistically significant. So, it implies that increase in student's engagement can increase the student's mathematical achievement.

Table 6: ***Relationship between student's cognitive engagement and student's mathematical achievement***

		Cognitive engagement	Students' mathematical achievement
Cognitive engagement	Pearson Correlation	1	.461**
	Sig. (2-tailed)		.000
	N	600	600

**. Correlation is significant at the 0.01 level (2-tailed).

Table shows the results that Correlation coefficient (r) value between cognitive engagement and mathematical achievement is 0.461 which shows that there is a positive moderate association between the variables. The p value < 0.01 which means that relationship is statistically significant .Hence it implies that increase in student's cognitive engagement can increase the student's mathematical achievement.

Table 7: ***Relationship between student's social engagement and student's mathematical achievement***

		Social engagement	Students' mathematical achievement
Social engagement	Pearson Correlation	1	.355**
	Sig. (2-tailed)		.000
	N	600	600

**. Correlation is significant at the 0.01 level (2-tailed).

Table reveals the result of correlation coefficient that r value between student's social engagement and mathematical achievement is 0.355 which indicates a positive weak association between the variables. The p value< 0.01 which means that relationship is statistically significant. So, increase in student's social engagement can increase the student's mathematical achievement

Table 8: ***Relationship between student's emotional engagement and student's mathematical achievement***

		Emotional engagement	Students' mathematical achievement
Emotional engagement	Pearson Correlation	1	.048
	Sig. (2-tailed)		.000
	Sig. (2-tailed)	600	.237

**. Correlation is significant at the 0.01 level (2-tailed).

Table shows the result of Correlation coefficient that r value between student's emotional engagement and student's mathematical achievement is 0.48 which is less than 0.1 so result shows no apparent correlation between the variables. The p value is 0.237 (p> 0.01) which implies that no relationship exists between student's emotional engagement and student's mathematical achievement.

Table 9: *Coefficients results for cognitive engagement and mathematical achievement*

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
	.173	.046		3.737	.000
Cognitive engagement	.149	.012	.461	12.687	.000

Dependent Variable: Math

According to the above table, effect of cognitive engagement (*B*=.461; t=12.687; p=.000), increasing cognitive engagement by one unit has a 0.461-unit impact on students' mathematical Further, beta values are positive which indicate the positive effect of student's cognitive engagement on student's Mathematical achievement, or in other words, when cognitive engagement increases by one unit, student's mathematical achievement increases by 0.461 units

Table 10: ***Coefficients results for social engagement and mathematical achievement***

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
	.342	.045		7.646	.000
Social engagement	.107	.012	.355	9.293	.000

a. Dependent Variable: math's

The table illustrates the coefficients results of effect of social engagement (*B*= 0.355; t=9.293; p=.000) on mathematical achievement. It implies that change in independent variable i.e. social engagement by one unit bring about a change in dependent variable i.e. students' mathematical achievement by 0.355 units. Further, beta values are positive which indicates the positive effect of student's social engagement on student's mathematical achievement.

Table 11: ***Coefficients results for students' emotional engagement and student's mathematical achievement***

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
	.696	.048		14.570	.000
Emotional engagement	.016	.014	.048	1.183	.237

a. Dependent Variable: math's

The table shows the coefficients results of emotional engagement (*B*=.048; t= 1.183; p=.237) it indicates beta value is 0.048 which is less than 0.1 also p>.005 so no significant effect of student's emotional engagement is found on mathematics achievement.

Table 12*: Coefficients results for students' engagement and student's mathematical achievement*

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
	.252	.058		4.358	.000
Students' engagement	.135	.015	.335	8.709	.000

a. Dependent Variable: math's

Table shows the coefficients results of effect of student's overall engagement on students' mathematical achievement (*B*=.335; t=8.709; p=.000) it exhibits independent variable i.e. students' engagement has effect on dependent variable i.e. students' mathematical achievement. Further, beta values are positive which shows the positive effect of student' engagement on student's mathematical achievement, or we can say that more the student's engagement more be the student's mathematical achievement.

Discussion and conclusion

Students' engagement in learning mathematics can be understood through three distinct yet interconnected dimensions: cognitive, social, and emotional engagement. Cognitive engagement refers to the level of mental effort and investment students put into understanding mathematical concepts and solving problems. Students with high cognitive engagement actively seek to comprehend underlying principles, apply mathematical reasoning to solve complex problems, and make connections between new and prior knowledge. On the other hand, students with lower cognitive engagement may rely on memorization without a deep understanding of the material or struggle to apply mathematical concepts in different contexts (Zhang, Yang, Sun, & Kaiser, 2023). Social engagement in mathematics involves how students interact with their peers, teachers, and learning environment. High levels of social engagement are characterized by active collaboration in problem-solving, participation in group discussions, and the exchange of ideas during math tasks. Students who are socially engaged benefit from peer learning, where discussing strategies and sharing different perspectives enhances their understanding (Roche, Gervasoni, & Kalogeropoulos, 2023). Conversely, low social engagement may manifest as reluctance to collaborate or limited interaction with others, leading to missed opportunities for learning through social interactions.

Emotional engagement encompasses students' feelings and attitudes toward mathematics, such as their interest, motivation, and confidence. When students are emotionally engaged, they are more likely to enjoy math, feel confident in their ability to succeed, and remain persistent in the face of difficulties. High emotional engagement fosters a positive relationship with mathematics, reducing math anxiety and building resilience. In contrast, students with low emotional engagement may experience frustration, boredom, or anxiety, which can lead to disengagement from learning and hinder their overall progress in mathematics (Jansen, et al., 2023). The effect and relationship between students' social engagement and mathematical achievement is often described as weakly positive, meaning that while collaboration and peer interaction can enhance understanding, their impact on actual achievement may be limited. Socially engaged students benefit from sharing strategies and ideas, which can help clarify concepts and build confidence in problem-solving. However, social interactions alone may not be enough to significantly boost mathematical performance, especially if cognitive and emotional engagement are lacking (Hettinger, Lazarides, & Schiefele, 2023). Therefore, while social engagement contributes to a positive learning environment, it may not strongly predict higher achievement in mathematics on its own.

The relationship between students' cognitive engagement and mathematical achievement, though positive, tends to be weak in some cases. This suggests that while students who actively engage in understanding mathematical concepts may show improved performance, the impact is not always substantial. Factors such as the quality of instruction, students' prior knowledge, and their ability to apply cognitive strategies effectively may influence the strength of this relationship. Additionally, other forms of engagement, such as emotional or social, may play a more significant role in shaping overall math achievement, highlighting the need for a well-rounded approach to student engagement (Akman, & Çakır, 2023). When studies show no relationship between students' emotional engagement and mathematical achievement, it suggests that positive emotions or interest in math do not necessarily translate into higher performance. While emotional engagement can enhance motivation and enjoyment, it may not directly influence students' ability to grasp mathematical concepts or solve complex problems. Other factors, such as cognitive strategies, instructional quality, or external support, may play a larger role in determining mathematical achievement (Ifamuyiwa, Asanre, & Abiodun, 2024). This finding highlights the need to consider a broader range of influences beyond emotions when seeking to improve math performance.

It was concluded that the relationship between students' cognitive, social, and emotional engagement and their mathematical achievement is closely intertwined. High cognitive engagement leads to deeper understanding and better problem-solving abilities, directly enhancing math performance. Social engagement facilitates collaborative learning, allowing students to share strategies and build on each other's ideas, which can improve their comprehension and achievement in math. Emotional engagement, such as a positive attitude toward math and confidence in their abilities, boosts motivation and persistence, leading to better outcomes. Together, these forms of engagement create a supportive environment for higher mathematical achievement.

References

1. Abd Wahid, N., & Shahrill, M. (2014). Pre-university students' engagement towards the learning of mathematics. *Proceeding of the Social Sciences Research ICSSR*, 379-388.
2. Akman, E., & Çakır, R. (2023). The effect of educational virtual reality game on primary school students' achievement and engagement in mathematics. *Interactive Learning Environments*, *31*(3), 1467-1484.
3. Baroody, A. E., Rimm-Kaufman, S. E., Larsen, R. A., & Curby, T. W. (2016). A multi-method approach for describing the contributions of student engagement on fifth grade students' social competence and achievement in mathematics. *Learning and individual differences*, *48*, 54-60.
4. Cevikbas, M., & Kaiser, G. (2022). Student engagement in a flipped secondary mathematics classroom. *International Journal of Science and Mathematics Education*, *20*(7), 1455-1480.
5. Goldin, G. A. (2014). Perspectives on emotion in mathematical engagement, learning, and problem solving. In *International handbook of emotions in education* (pp. 391-414). Routledge.
6. Goldin, G. A., Epstein, Y. M., Schorr, R. Y., & Warner, L. B. (2011). Beliefs and engagement structures: Behind the affective dimension of mathematical learning. *ZDM*, *43*, 547-560.
7. Hettinger, K., Lazarides, R., & Schiefele, U. (2023). Motivational climate in mathematics classrooms: Teacher self-efficacy for student engagement, student-and teacher-reported emotional support and student interest. *ZDM–Mathematics Education*, *55*(2), 413-426.
8. Hong, W., Zhen, R., Liu, R. D., Wang, M. T., Ding, Y., & Wang, J. (2020). The longitudinal linkages among Chinese children's behavioural, cognitive, and emotional engagement within a mathematics context. *Educational Psychology*, *40*(6), 666-680.
9. Ifamuyiwa, A. S., Asanre, A. A., & Abiodun, T. O. (2024). Prediting Mathematics Student S'Learning Outcomes in Senior Secondary School using Dimensions of Academic Engagement. *EDUCATUM Journal of Science, Mathematics and Technology*, *11*(1), 15-22.
10. Jansen, A., Curtis, K., Mohammad Mirzaei, A., Cullicott, C. E., Smith, E. P., & Middleton, J. A. (2023). Secondary mathematics teachers' descriptions of student engagement. *Educational Studies in Mathematics*, *113*(3), 425-442.
11. Joshi, D. R., Adhikari, K. P., Khanal, B., Khadka, J., & Belbase, S. (2022). Behavioral, cognitive, emotional and social engagement in mathematics learning during COVID-19 pandemic. *PloS one*, *17*(11), e0278052.
12. Kong, Q. P., Wong, N. Y., & Lam, C. C. (2003). Student engagement in mathematics: Development of instrument and validation of construct. *Mathematics Education Research Journal*, *15*(1), 4-21.
13. Lin, F. L., Wang, T. Y., & Yang, K. L. (2018). Description and evaluation of a large-scale project to facilitate student engagement in learning mathematics. *Studies in Educational Evaluation*, *58*, 178-186.
14. Lo, C. K., & Hew, K. F. (2021). Student engagement in mathematics flipped classrooms: Implications of journal publications from 2011 to 2020. *Frontiers in Psychology*, *12*, 672610.
15. Martin, D. P., & Rimm-Kaufman, S. E. (2015). Do student self-efficacy and teacher-student interaction quality contribute to emotional and social engagement in fifth grade math?. *Journal of school psychology*, *53*(5), 359-373.
16. Maamin, M., Maat, S. M., & H. Iksan, Z. (2021). The influence of student engagement on mathematical achievement among secondary school students. *Mathematics*, *10*(1), 41.
17. Rimm-Kaufman, S. E., Baroody, A. E., Larsen, R. A., Curby, T. W., & Abry, T. (2015). To what extent do teacher–student interaction quality and student gender contribute to fifth graders' engagement in mathematics learning?. *Journal of educational psychology*, *107*(1), 170.
18. Roche, A., Gervasoni, A., & Kalogeropoulos, P. (2023). Factors that promote interest and engagement in learning mathematics for low-achieving primary students across three learning settings. *Mathematics Education Research Journal*, *35*(3), 525-556.
19. Sen, E. O. (2022). Middle School Students' Engagement in Mathematics and Learning Approaches: Structural Equation Modelling. *Pedagogical Research*, *7*(2).
20. Watt, H. M., Carmichael, C., & Callingham, R. (2017). Students' engagement profiles in mathematics according to learning environment dimensions: Developing an evidence base for best practice in mathematics education. *School Psychology International*, *38*(2), 166-183.
21. Yang, Y., Yuan, Y., Tan, H., Wang, Y., & Li, G. (2021). The linkages between Chinese children's both cognitive engagement and emotional engagement and behavioral engagement: Mediating effect of perceptions of classroom interactions in math. *Psychology in the Schools*, *58*(10), 2017-2030.

22. Zhang, Y., Yang, X., Sun, X., & Kaiser, G. (2023). The reciprocal relationship among Chinese senior secondary students' intrinsic and extrinsic motivation and cognitive engagement in learning mathematics: A three-wave longitudinal study. *ZDM–Mathematics Education*, *55*(2), 399-412.