

Social Sciences Spectrum

A Double-Blind, Peer-Reviewed, HEC recognized [Y-category](#) Research Journal

E-ISSN: [3006-0427](#) P-ISSN: [3006-0419](#)

Volume 04, Issue 02, 2025

Web link: <https://sss.org.pk/index.php/sss>



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Students' Engagement and Their Academic Performance in STEM and Non-STEM Elementary Schools

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Article Information [YY-MM-DD]

Received 2025-02-20

Accepted 2025-04-20

Citation (APA):

Ghawas, S, A., Munir, F & Khalid, L. (2025). Students' engagement and their academic performance in STEM and Non-STEM elementary schools. *Social Sciences Spectrum*, 4(2), 199-217. <https://doi.org/10.71085/sss.04.02.264>

Abstract

Academic performance is connected to student engagement across different educational settings such as STEM versus non-STEM elementary schools. In this study, I explore the differences of student engagement and academic performance in STEM and non-STEM elementary schools. The study was a cross-sectional survey design using a quantitative approach. There was a population of 300 students made up of 300 students from non-STEM schools and 300 students from STEM schools. Extensive participation disparities across the two school types is highlighted by the study. The study finds students in STEM schools to be more motivated, class participative, which also results in having more interaction with teachers and peers, as well as better academic performance in general. Active, inquiry based teaching methods and incorporation of common modern technology in STEM settings are associated with these outcomes. On the other hand, non-STEM schools have lower engagement levels than STEM schools, specifically in peer collaboration and support from teachers. Consequently, the study concludes that non-STEM schools should adopt STEM pedagogies, develop their teaching infrastructure and present the curriculum reform, teacher training and the allocation of resources that ought to improve learning experiences in all educational contexts.

Keywords: Academic performance, learning motivation, Student engagement, STEM education, non-STEM education, Teacher support.



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Introduction

Student engagement is critical to achievement. The most transformative learning happens in early education and establishes both cognitive and behavioral foundations. In this period of formative years, how students themselves choose to act in their learning experiences carries great potential to determine both the quality of their succeeding schooling and their subsequent educational pathways. Positive educational outcomes depend on to what extent students become emotionally, behaviorally and cognitively engaged in learning activities (Lawson & Lawson, 2017). Despite that, levels of engagement tend to differ based on the area of study, marked differences between STEM (Science, Technology, Engineering, and Math) subjects and other subjects like the arts, humanities, and social studies. Finally, this variation presents potential questions as to the nature of the factors that influence students' interest, involvement and achievement in various parts of the curriculum. The STEM aspect has taken a prominent place in recent educational reforms as it is perceived and recognized to be an enabler or potential driver of economic development, to spur innovation and to educate students for future workforce requirements of the 21st century (e.g. Marginson et al., 2017). It is a widely known fact that global institutions and governments have put in considerable resources to encourage the taking of STEM subjects in schools, arguing that they entail equipping learners with critical thinking, problem solving and technical skills that underpin functioning in emerging labour markets (Freeman et al., 2017; OECD, 2010).

This, however, has led to the growth of a concerning trend wherein students (especially in the elementary school level) tend to lose interest and engagement in STEM disciplines in the course of time. Students find these subjects to be complex, abstract and discouraging in terms of academic performance and in turn, they lose interest in pursuing STEM careers (Chiu et al., 2018; Anderson & Li, 2023). Early disengagement can have long term consequences leading to fewer educational and career opportunities in the academic and professional realms of STEM. On the other hand, though, arts and humanities, and social science type subjects tend to enlist more enthusiasm and long-term students. As a rule, this kind of subjects provides more creatively, expressive and relatable content that makes students feel more emotional and cognitive investment of learning. Therefore, there were subjectivity reports related to satisfaction in the areas and better academic results by students (Garcia & Moreno, 2023). Literature, history and the arts courses are also important in teaching, among other things, literacy, communication, and social interaction skills, and such courses develop imagination and empathy (Bertram, 2020; Ewing, 2018). Importantly, these engagements in non-STEM fields also provide skills that help fill in employment skills in technical areas, like in jobs that require collaboration, adaptability, and emotional intelligence as more and more jobs require people to be outside of their technical field of expertise.

It highlights the importance to educational research of understanding the root cause of such disparity in engagement and performance in STEM compared to non-STEM subjects. As an ardent supporter of STEM, I would be in favor of creating future-ready students, however, overemphasis on technical discipline at the expense of educational development in other subject areas may weight student learning experience and skills GS (2017). Not only that; treating STEM and non-STEM subjects as disjoint silos totally ignores the benefits of looking at education in an integrated and holistic manner. Research indicates that students who are engaged in a broad variety of topics—both STEM and non-STEM—tend to have better academic performance as well as a more comprehensive development. Because supporting more inclusive and effective learning environments requires an understanding of how and why students engage differently across different subjects, it is necessary to learn more about how students learn and what affects that learning (Rafiq, Kamran & Afzal, 2024). If we can identify the factors that determine engagement,

they can help inform the design of teaching strategies, curriculum, and policy choices that will more effectively serve the interests and needs of the manifold students. According to Carter et al. (2023) and Zhao & Xu (2023), it can also be used to identify more effective methods to engage students to participate and succeed in all subject areas. This research evaluates the association between student engagement and academic performance in STEM and non-STEM disciplines at primary school level. Through comparison of student experience in these fields, the study aims to inform educators and policymakers on the ways they can improve student engagement, boost performance, and promote more equitable educational outcomes at an early age.

The significance of this study is to educators, policymakers, and the researchers but as they explore the differences in student engagement and academic performance of the STEM and non-STEM subjects at elementary level in order to equip practitioners with practical insights regarding how to make teaching strategies more balanced and inclusive. The findings are consistent with the evidence-based reforms in curriculum design and pedagogy, which enable enhancing overall student participation and performance as well as long term educational outcomes. The purpose of this study is to examine key factors that impact student participation in elementary STEM schools compared to non-STEM schools and measured academic performance and student engagement. Secondly it intends to provide information for educational policy and strategy shaping so as to promote student involvement and attaining in all subjects for holistic educational development.

Literature Review

The studies show how complexities of student engagement in STEM and elementary education, both STEM and non-STEM, are related with cognitive, emotional, and behavioral character of the students and their subsequent academic performance (Gadd et al., 2014; Kamran, Afzal & Rafiq, 2022). It acknowledges disparities in how these two disciplines go about these engagements strategies and seeks to explain what effect these differences have on learning outcomes provided. Yet, there is limited research on student engagement, especially for early learners as much of the literature focuses on middle and high school student for whom there hasn't been much clarity on how engagement strategies translate to younger children (Fredricks et al., 2016; Fredricks et al., 2021). In addition, it is necessary to tailor the engagement to the particular students in the class, since cultural, social status, learning ability and sex of the students affect just how they engage with STEM and non-STEM content. For instance, a number of societal barriers face female students in STEM (Bottia et al., 2018), and low income students tend to have fewer supports and thus face access and concentration barriers (Blazar & Kraft, 2017). Still it is few studies that consider these variables at the level of excellence elementary, since is known that early intervention is crucial to the success academic long term (Gutiérrez and Jurow 2016, Wang and Eccles, 2021).

While it is widely acknowledged that engagement in learning is integral, current work largely remains limited to students at the secondary and postsecondary levels, leaving a significant knowledge gap about engagement at the elementary level, with the development of positive academic habits and attitudes occurring first (Skinner & Pitzer, 2012). Although there are studies that have proven that early engagement leads to long-lasting interest in academics and positive attitudes in respect to academics (Fredricks et al., 2016; Afzal, & Rafiq, 2022), educators' competence is hindered because as younger learners, they don't really pay attention to them in the interest of STEM to the point of dropping out with age (Rimm-Kaufman & Hulleman, 2021). Additionally, little longitudinal research exists that follows through what early engagement contributes to academic trajectories in later life stages, particularly in STEM subject areas where early disinterest often continues (Reeve, 2013; Fredricks et al., 2020).

Moreover, although technology is known to increase engagement with technology in older students (Herro et al., 2017), the role of technology in secondary level education to support engagement is underexplored. Although they found that tablets and educational games increased STEM interest among middle schoolers (Kiger, Herro, and Prunty, 2012), there are no similar studies specific to younger students. Technology has been suggested to facilitate the engagement in historically difficult activities such as math and science (Bolliger & Martin, 2021), yet relatively little has been written about effective integration of educational technology into elementary classrooms (Bond, 2021). A large field of academic literature points out the major importance of STEM (Science, Technology, Engineering, and Mathematics) education in developing analytical thinking, creativity, and problem solving that are central to the process of modern economic and industrial development (Bottia et al., 2018). Nevertheless, initial excitement of STEM for students is still a concern that typically wanes for students on account of complex content and uninspiring teaching methods (DeWitt & Archer, 2015; Maltese & Tai, 2011). Many researchers support inquiry based learning as a way of keeping students interested and understand in STEM disciplines (NRC, 2012; Duran et al., 2020; Hsu et al., 2021).

A major barrier to STEM engagement is sustaining student interest when lessons become more complex and abstract, especially with the influence of the traditional lecture based method typically prioritized instruction (Wang & Degol, 2017). Meaningful learning requires engagement and this requires dynamic differentiated teaching, addressing different learner needs. Additionally, students are highly influenced by the teachers' expectations as well as the general environment of the classroom regarding participation. Faced with high expectations and supportive classroom climates, involvement tends to increase, especially for marginalized students, for example low income or females (Maltese & Tai, 2011). So can hands on learning experiences and the strategic use of classroom resources and technology. Learning is made interactive with activities such as: experiments, coding projects, the use of digital tools (Rafiq, Zaki & Nawaz, 2025), such as simulations and virtual labs (Rafiq, Iqbal & Afzal, 2024; Geisinger & Raman, 2013; Zhou et al., 2020; Bond, 2021). Discussion of real world applications such as climate change or political issues are included in STEM lessons that are related to practice and therefore in theory, makes learning the theory more relevant as well as more interesting to students (Duran et al., 2020). Additionally, studies demonstrated that students taking part to projects that address environmental issues were more engaged in comparison to students in traditional classrooms (Hsu et al., 2021), which indicates that the way we design our curricula should be socially responsive and contextually meaningful at the same time.

Theoretical Framework

There are two theories that purport to explain student engagement and achievement. Self-Determination Theory (SDT) and Expectancy Value Theory (EVT). SDT explains that this leads students to desire to feel that they are autonomous, capable, and connected to others. In STEM Education, SDT focuses on identifying activities that facilitate students to explore on their own, solve problems of their own, and experience achievement. EVT describes student engagement as a student's perception of how much they value a task, and the degree to which they believe themselves capable of doing so. Personal relevance also increases students' engagement in STEM subjects, when they view utility of the subject for future careers and in non-STEM subjects, when they find personal or emotional relevance in the content.

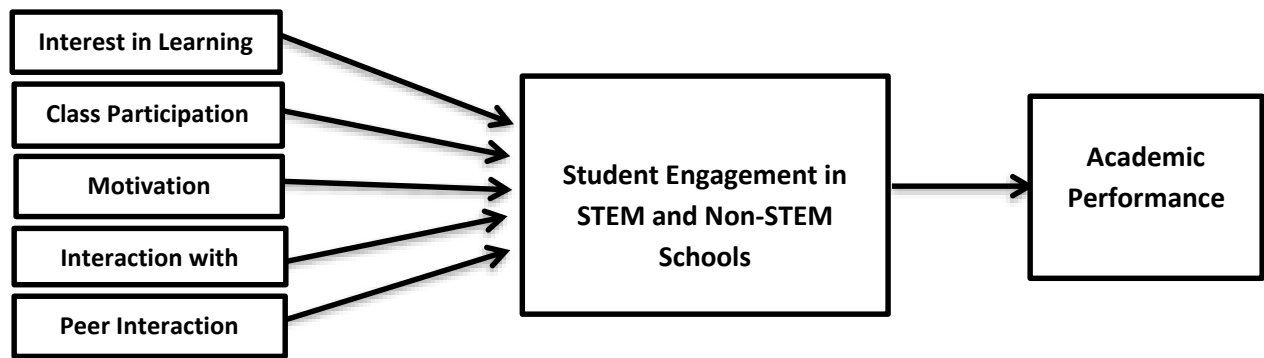


Figure 1.1: *Conceptual Framework*

The conceptual framework provides the importance of student engagement not just in STEM schools but also in non-STEM schools. It learns five important factors – interest in learning, class participation, motivation, teacher interaction and peer interaction. Student’s interest in learning is a student will to learn and use various learning skills. A sample of class participation consists of students’ participation in lectures, group work, and other class activities. Therefore, motivation, i.e. motivation by extrinsic rewards or intrinsic motivation, is very important in academic performance. A positive learning atmosphere encourages teacher student interaction where students are allowed to ask questions and gain explanations on the context. It encourages peer’s interaction achieving group work skills and feeling sense of belonging. If these factors are present, the model propositions that students' academic experience is greatly improved. Student engagement is a direct effect that affects academic performance, as those who are most engaged tend to have better grades, learn more, obtain needed skills for education or career.

Methodology

A positivist paradigm and a comparative cross sectional survey research design, a quantitative research approach was taken in the study. The sample of this study was 300 students from Swat Pakistan, 150 students were from STEM schools and 150 were from non-STEM schools. In fact, the ten STEM schools were included alongside the ten non-STEM schools in order for the study to consist of a reasonably representative sample. Descriptive and inferential statistics were used in doing an analysis. There were seven defined variable items and each having four descriptions of that variable, which made a total of twenty-eight items.

Data Analysis and Interpretation

Descriptive and inferential statistical techniques are applied to statistical patterns, relationships, and differences among the student groups

An effort of this study is to examine student engagement and academic performance in STEM and non-STEM primary schools based on six key factors of learner Interest in learning, Class participation, Motivation, Teacher support, Peer interaction and Academic performance. How engagement impacts performance across school settings: these components evaluate how students are motivated, involved in class, persevered, supported by systems, collaborated with peers and academic outcomes.

Table 1.1: Frequency and Percentage of the “Demographics”

Sr.#	Gender	<i>f</i>	% Responses
1	Male	76	50.7
2	Female	74	49.3
	Total	150	100

Sr.#	Parental Education Level	<i>f</i>	% Responses
1	Primary	53	35.3
2	Secondary	43	28.7
3	Higher Education	54	36.0
	Total	150	100

Sr.#	Grade	<i>f</i>	% Responses
1	2	36	24.0
2	3	43	28.7
3	4	34	22.7
4	5	37	24.7
	Total	150	100

Table 1.1 shows the demographics of students based on their frequencies and percentage of occurrence.

Table 1.2: Factor 1 “Interest in Learning (IIL)” Percentage Responses

Item	<i>SDA%</i>	<i>D%</i>	<i>N%</i>	<i>A%</i>	<i>SA%</i>	<i>M</i>	<i>SD</i>
I find the subjects I study in school interesting.	20.7	20.0	24.7	18.0	16.7	2.90	1.36
I enjoy participating in classroom discussions.	8.7	18.7	20.0	29.3	23.3	3.40	1.26
I look forward to learning new topics in my classes.	13.3	12.0	22.7	28.7	23.3	3.36	1.32
I am curious about how things work in the world around me.	10.0	16.7	18.0	34.7	20.7	3.39	1.26

The results from Interest in Learning indicate moderate levels of student engagement. The item “I find the subjects I study in school interesting” had a low mean of 2.90 (SD = 1.36), 40.7% agreed, and 59.3% disagreed. As opposed to, “I enjoy participating in classroom discussions” (M = 3.40, SD = 1.26) and “I look forward to learning new topics” (M = 3.36, SD = 1.32) more than 52% of the students were reported as having a positive response. The mean for this statement was 3.39 (SD = 1.26); 34.7% agreed. However, overall students are not very curious and motivated, and many find subjects uninspiring.

Factor 2: “Class Participation (CP)” Percentage Responses

<i>Item</i>	<i>SDA%</i>	<i>D%</i>	<i>N%</i>	<i>A%</i>	<i>SA%</i>	<i>M</i>	<i>SD</i>
I actively participate in group activities and projects.	17.3	12.0	24.0	20.0	26.7	3.26	1.42
I feel comfortable asking questions in class.	22.0	18.0	19.3	21.3	19.3	2.98	1.43
I contribute my ideas during class discussions.	16.7	22.0	18.7	22.0	20.7	3.08	1.39
I enjoy sharing my thoughts with my classmates.	20.0	17.3	26.0	20.0	16.7	2.96	1.36

In non-STEM schools, Class Participation leads to moderate engagement but has only low enthusiasm. However, only 46.7 % of students stated that they had participated in group activities while 29.3 % stated that they were unwilling. Seventy-seven percent felt uncomfortable asking questions in class, and nearly 40% felt uncomfortable asking them. There was also tendency of participation in discussions and sharing ideas which both leaned to disagreement or neutrality. Scores on the mean ranged from 2.96 to 3.26 which indicated a lack of undivided support for the involvement. The results of these findings indicate that there exists a need for increased motivation and more engaging classroom activities to promote increased participation in non-STEM environments.

Table 1.3: Factor 3 “Motivation (M)” Percentage Responses

<i>Item</i>	<i>SDA%</i>	<i>D%</i>	<i>N%</i>	<i>A%</i>	<i>SA%</i>	<i>M</i>	<i>SD</i>
I set personal goals for my academic performance.	16.0	18.7	18.7	18.0	28.7	3.24	1.45
I feel motivated to complete my homework and assignments.	20.7	16.0	18.7	24.0	20.7	3.08	1.43
I strive to do my best in all my subjects.	16.0	14.0	30.0	20.0	20.0	3.14	1.33
I push myself to improve my grades.	18.8	20.7	19.3	18.7	22.7	3.06	1.43

The data of motivation (M) among non-STEM school students indicates moderate academic drive with uneven self-discipline and goal setting. Out of 46.7 percent of students, 34.7 percent disagreed or strongly disagreed that they established personal academic goals, suggesting a gap in goal orientation. Interestingly, about 37% felt demotivated on assignments and the same amount of 37.5% lacked motivation for enhancing grades. General lack of proactive academic ambition shows up in response to striving for excellence (30%) as additional neutral responses. These findings, therefore, suggest the need for additional educational support, the provision of structured goal setting and motivational strategies, in schools that are not in STEM.

Table 1.4: *Factor 4 “Teacher Support (TS)” Percentage Responses*

<i>Item</i>	<i>SDA%</i>	<i>D%</i>	<i>N%</i>	<i>A%</i>	<i>SA%</i>	<i>M</i>	<i>SD</i>
My teachers encourage me to ask questions and express my thoughts.	20.7	21.3	21.7	17.3	19.3	2.93	1.41
I receive feedback on my work that helps me improve.	18.7	20.7	22.7	16.7	21.3	3.01	1.40
My teachers make learning enjoyable and engaging.	19.3	20.0	16.0	21.3	23.3	3.09	1.45
I feel that my teachers care about my success.	13.3	25.3	20.7	18.0	22.7	3.11	1.36

Results from the Teacher Support (TS) in non-STEM schools show moderate support but with concerning knowledge gaps. The amount of students who indicate that teachers do not encourage or strongly do not encourage them to ask questions and share ideas about 42 percent. In addition to that, 39.4% believe that they get no helpful feedback, and 39.3% say they are not engaged in active learning. In addition, 38.6 percent are doubting their teachers’ care about their academic success. These findings are moderate in support with mean scores ranging from 2.93 to 3.11 while it is underlined that the teachers need to use more effective interactions with students, provide regular constructive feedback and use activities that involve active engagement.

Table 1.5: *Factor 5 “Peer Interaction (PI)” Percentage Responses*

<i>Item</i>	<i>SDA%</i>	<i>D%</i>	<i>N%</i>	<i>A%</i>	<i>SA%</i>	<i>M</i>	<i>SD</i>
I work well with my classmates on group projects.	26.0	21.3	22.0	11.3	19.3	2.76	1.44
I feel supported by my friends in school.	20.0	18.7	21.3	24.0	16.0	2.97	1.37
I enjoy collaborating with others on assignments.	20.7	20.0	22.0	19.3	18.0	2.94	1.39
My peers encourage me to do my best.	25.3	19.3	20.7	17.3	17.3	2.82	1.43

In several non-STEM schools, weak peer collaboration and support is also observed in terms of Peer Interaction (PI) data. More than half of the students (47.3 per cent) disagree or strongly disagree to working efficiently in groups and 38.7 per cent have no supportive friends to rely on. Furthermore, 40.7 percent are unwilling to work together on assignments, 44.6 percent do not, over half fail to feel appreciated by peers for academic success, while 34.6 percent do. The results have mean scores of 2.76 to 2.97, suggesting generally negative or neutral peer dynamics to social learning environments, suggesting the need for structured and engaging peer based activities.

STEM Schools

H3: At the elementary school level, there is a great difference in the mean scores of student engagement and academic achievement by gender.

1. T-test at the bases of Gender.

Table 1.6: Mean difference between scores of Students' Academic Performance

Variables	M	SD	t- value	Sig.
Male	81.75	6.64	-.121	.735
Female	81.87	6.51		

The means (M) academic performance scores for males (M = 81.75, SD = 6.64) and females (M = 81.87, SD = 6.51) were essentially the same. The independent t test returned a t value of -0.121 and p value of 0.735, less than 0.05 and thus implying there is no statistically significant difference between genders. Therefore, H3 is rejected and gender has little effect on academic performance.

H2:

Mean score of student's engagement differs significantly relative to their academic achievement in a STEM and a non-STEM education system at the elementary school level.

2. One-way ANOVA at the bases of Student Ages

Table 1.7: Mean difference between scores of Students' Academic Performance

Variables	M	SD	F- value	Sig.
Grade 2	82.05	8.17	.519	.670
Grade 3	81.67	5.55		
Grade 4	80.79	5.06		
Grade 5	82.67	6.83		

Results of the one-way ANOVA to compare academic performance of different grade levels do not indicate statistically significant differences. The following mean scores were obtained: Grade 2 = 82.05 (SD = 8.17), Grade 3 = 81.67 (SD = 5.55), Grade 4 = 80.79 (SD = 5.06) and Grade 5 = 82.67 (SD = 6.83). The F value was 0.519 and had a p value of 0.670, which is greater than 0.05 significance threshold. Thus age (as measured by grade level) does not affect student academic performance in this sample to a great extent.

H4: *Variations between students' engagement on STEM and non-STEM elementary education are massively determined by strong influencing factors.*

3. Descriptive Analysis at the bases of Factors

Table 4.2.4: Mean difference between scores of Students' Academic Performance

Factors	M	SD
Interest in learning	13.0	2.48
Class Participation	13.6	2.47
Motivation	13.6	2.65
Interaction with Teachers	13.8	2.76
Peer Interaction	13.4	2.61
Overall Engagement	14.1	2.16

The results showed that the mean and standard deviation of the other factors of engagement in the elementary school education in STEM and non-STEM were teacher interaction ($M = 13.8$, $SD = 2.76$) followed by motivation ($M = 13.6$, $SD = 2.65$), third that was class participation ($M = 13.6$, $SD = 2.47$). The ratings for interest in learning ($M = 13.0$, $SD = 2.48$) and peer interaction ($M = 13.4$, $SD = 2.61$) were slightly below zero. $M = 14.1$; $SD = 2.16$, indicative of all the factors having a significant impact, but the impact varies. Indeed, given the analysis, improving teacher interaction and teacher motivation can greatly improve student engagement, verifying Hypothesis H4.

Non -STEM Schools:

H3: At the elementary school level, the mean scores of student engagement differ significantly from the mean scores of academic achievement based on gender.

4. T-test at the bases of Gender.

Table 1.8: Mean difference between scores of Students' Academic Performance

Variables	M	SD	t- value	Sig.
Male	72.97	6.78	1.89	.906
Female	70.92	6.43		

The difference of mean academic scores between male and female respondents in Non-STEM schools was analysed by an independent samples t-test. Though the difference was not statistically significant ($T = 1.89$, $p = 0.906$), male students ($M = 72.97$, $SD = 6.78$) outperformed female students ($M = 70.92$, $SD = 6.43$). As the p value is greater than 0.05, it can be said that gender has no substantial effect on academic performance in Non-STEM schools. Therefore, Hypothesis H3 is rejected.

H2: At elementary school level, there is a significant difference of the mean score of students' engagement and their academic achievement in STEM and non-STEM education system.

5. One-way ANOVA at the bases of Grade Level

Table 1.9: Mean difference between scores of Students' Academic Performance

Variables	M	SD	F- value	Sig.
Grade 2	71.80	6.95	1.53	.207
Grade 3	74.13	7.17		
Grade 4	70.92	6.16		
Grade 5	71.04	5.84		

To compare the academic performance for different age groups in non-STEM schools, a one-way ANOVA test was done. Students in Grade 2, Grade 3, Grade 4 and Grade 5 had mean scores of 71.80, 74.13, 70.92 and 71.04 respectively. There was some variation in the performance, but the F-value of 1.53 and p value of 0.207 shows that the differences are not significant statistically. It is therefore safe to say that grade level does not differ much in academic performance in non-STEM school. Consequently, Hypothesis H2 is rejected.

H4: Variation of student's engagement in STEM and non-STEM elementary education are distinctly affected by many factors.

4. Descriptive Analysis at the bases of Factors

Table 1.10: Mean difference between scores of Students' Academic Performance

Factors	M	SD
Interest in learning	11.8	2.75
Class Participation	12.2	2.74
Motivation	12.5	2.89
Interaction with Teachers	12.1	2.80
Peer Interaction	11.5	2.93
Overall Engagement	11.6	2.60

Results of the motivational analysis in non-STEM elementary education show that the highest motivation MS (M = 12.5, SD = 2.89) is the strongest motivational driver for student engagement. The next was class participation (M = 12.2, SD = 2.74), then teacher interaction (M = 12.1 as well as SD = 2.80). Other considerations than did not include interest in learning (M = 11.8, SD = 2.75), peer interaction (M = 11.5, SD = 2.93), or overall engagement (M = 11.6, SD = 2.60). While not quite as high as motivation, nothing fell very far below, meaning that each one plays a role into raising the level of student engagement with non-STEM subjects.

Student engagement is determined to be motivated, class participation as key factors and all are largely equal contributors. Hypothesis H4 is confirmed since engagement is a combination of multiple elements.

H1: There is significance relationship between student engagement and their academic achievement at elementary school level.

Table 1.11: Relationship between STEM and NON- STEM schools

Variables	N	r- value	Sig.
STEM school	150	.76	.00
Non- STEM school	150	.38	.00

There is a strong positive relationship (both $p = 0.00$) in STEM schools ($r = 0.76$) as well as a moderate one ($r = 0.38$) in non-STEM schools. This shows the stronger association of student engagement with academic performance in STEM settings. Therefore, the hypothesis is accepted.

Conclusion

In this study, elementary students learned through STEM vs. non-STEM schools and was found that STEM students had more engagement, which was largely participated; due to active and problem based learning approaches. However, the engagement of the non-STEM students was significantly lower in peer interaction and teacher support.

The study showed a strong correlation between engagement and academic performance, that is a better performance in learning when there is higher engagement. Teaching methods, and classroom environment, parental education and teaching style were the key factors which influenced engagement (Rafiq, Afzal & Kamran, 2022).

The findings highlight a need for innovation and interactivity of teaching strategies in both STEM and non-STEM settings to address low participation and the academic distinction. Future research could extend the understanding of student engagement in physical school environment, social economic status and extra curriculum activity.

Discussion

The differences in student engagement and student academic performance between STEM and non-STEM elementary schools are also made clear. For the metrics of interest, participation, motivation, peer interaction, teacher support, STEM students were found to outscore their non-STEM counterparts across all peer schools. Such supports previous research that demonstrates that active, inquiry-based and technology enabled STEM curricula improve motivation and academic performance (Smith & Brown, 2020; Johnson et al., 2019). Hands on learning such as experiments and real world problem solving are able to benefit STEM students more than non-STEM schools because of the more traditional teaching method in non-STEM schools which decreases engaged in student. In addition, peer collaboration and teacher support were also quite more visibly stronger in STEM settings strengthening critical thinking and learning (Gonzalez & Wilson, 2022; Anderson & Kim, 2020). Interestingly, the study also found no statistically significant influence from parent education level or student age on performance as was reported in the past studies (Baker et al., 2018). Thus, this implies that school quality, pedagogy, and motivation of students influence the students' performance. However, since these insights, policies and educators should take in mind to apply STEM informed strategies in non-STEM schools, which include project based learning, interactive teaching, and the use of technology. All disciplines should now take into account the strategies of student engagement in teacher training programs.

Recommendations:

Several recommendations are proposed based on the research findings to increase student participation and achievement in the STEM and the non-STEM elementary schools. They include the use of STEM lesson learning strategies like inquiry and projects based learning, use of modern technology in the curriculum, so adding to this, emphasis on teaching with a student oriented

approach like group learning and feedback based instruction. Active pedagogy is what should be focused on in teacher training and schools need to spend on up-to-date materials, smart classrooms, and virtual labs to enable interactive learning. Other things are equally important like peer collaboration, involvement of parents and personalized / self-directed learning. Furthermore, educational policies will also need to give priority to STEM integration, appropriate allocation of resources to fund infrastructure and teacher development, and conduct of long-term and socio-psychological impact studies across diversified school contexts.

Conflict of Interest

The authors showed no conflict of interest.

Funding

The authors did not mention any funding for this research.

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