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The Effect of Learning-Environment Factors on Learners' Academic Achievement in Mathematics in Public Mixed Day Secondary Schools in Marigat Sub-County, Kenya

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Abstract: ***Mathematics scores in Marigat Sub-County have trailed national averages for five consecutive years. In my view, the underperformance invites a closer look at contextual forces beyond the classroom. Guided by Gagne's learning-conditions theory, this descriptive survey sampled 12 principals, 24 teachers, and 120 Form Four students to examine whether physical, social, and climatic factors predict KCSE Mathematics outcomes. Descriptive statistics depicted adequate facilities yet recurrent high-temperature disruptions, while Pearson correlations (r = 0.054, p = 0.56) and regression analysis (beta = 0.056) showed no significant link between environment indices and mean grades. This suggests that attention should pivot to alternative influences-curricular pacing, teacher capacity, or student motivation-when devising intervention policy for semi-arid districts.***

Keywords: learning environment, mathematics achievement, secondary schools, Kenya, Marigat sub-county

1. Introduction

Mathematics is a key subject for the future through both its fundamental development and its enabling role for science, engineering, and technology (Pepin, Biehler, & Gueudet, 2021). The Kenyan government acknowledges the importance of Mathematics by making it a compulsory subject in both primary and secondary school. The government committed itself to improving performance in Mathematics and Science through in-service training of teachers in projects such as Strengthening mathematics and science in secondary education (SMASSE) and capacity building workshops. Despite all the efforts, there has been a decline of Mathematics performance in Kenya certificate of secondary education (KCSE) in the country for the last five years (2019-2023). The KCSE mathematics percentage means scores from 2019 to 2023 was 26.45, 27.0, 18.36, 20.03 and 15.195 respectively (KNEC report, 2024). The highest mean score was 27% for the year 2019 while the lowest mean is 15.195% for the year 2023. This is not a very good performance. The average scores also demonstrate a downward trend in performance over time. This is a worrying trend that has prompted the researcher to mount a study with a view to changing this trend. The same observation is also noted in Marigat Sub- County of Baringo County as shown in Table 1.

Table 1: KCSE Candidate's Performance in Mathematics in Baringo County from the year 2019 to 2023

SUB COUNTY	MEAN SCORES AND MEAN GRADES PER YEAR					
	2019	**2020**	**2021**	**2022**	**2023**	**Average**
Baringo central	3.28 D	3.63 D+	3.18 D	3.47 D	3.03 D	3.318 D
Baringo north	2.94 D	3.07 D	2.92 D	3.13 D	2.05 D-	2.822 D
Koibatek	2.77 D	3.15 D	2.96 D	3.01 D	2.15 D-	2.81 D
Mogotio	2.52 D	2.76 D	2.03 D-	2.45 D-	1.66 D-	2.284 D-
Marigat	***2.01 D-***	***2.104 D-***	***1.762 D-***	***1.875 D-***	***1.45 E***	***1.8402 D-***
Tiaty	1.94 D-	2.07 D-	1.56 D-	1.86 D-	1.35 E	1.756 D-
AVERAGE	**3.09 D**	**3.36 D**	**2.88 D**	**3.159 D**	**2.34 D-**	**2.97 D**

Source: Baringo County Educational Office (2024)

Table 1 shows that KCSE mean scores from year 2019 to 2023 as 3.09, 3.36, 2.86, 3.159 and 2.34 respectively with an average mean score of 2.97 which is a mean grade of D. This below-average performance shows that many students are not eligible for tertiary institution courses because they did not receive the required minimum grade of D+ in mathematics. Marigat sub-county has an average mean score of 1.8402(D-) for the last five years (2019-2023) which is below the county mean. When learners' score mean grade below D+ in Mathematics K.C.S.E examination, it reduces their career options and thereby limiting their success in tertiary education and beyond. This will result in decline of student's enrolment in tertiary Mathematics courses hence limiting the nation's resource base in science and technology. Marigat Sub County is a unique region in Kenya with harsh climatic condition, very poor land terrain, nomadic nature of the community and a lot of insecurity caused by banditry in the Neighbouring Tiaty sub county. For general perspective and consideration on factors affecting mathematics achievement, studies ought to be done in different region such as Marigat Sub County. This study was geared towards the filling of these gaps in knowledge and population by examining how learning environment factors affect leaners' mathematics achievement in K.C.S.E amongst learners in public mixed secondary school in Marigat Sub- County.

1.1 Objective of the Study

The specific objective of the study was to establish the effect of learning environment factors on learners' academic achievement in mathematics in public mixed day secondary schools in Marigat Sub-County.

1.2 Research Hypothesis

The following null research hypothesis was formulated from the specific objective above and tested at 0.05% significance level.

H_{01}: Learning environment factors have no statistically significant effect on academic achievement in mathematics in public mixed day secondary schools in Marigat Sub-County.

2. Literature Survey

The literature reviewed comprises: theoretical framework, learning environment and learners' academic achievement in Mathematics as well as the gap in the Literature

2.1 Theoretical Framework

This study was based on Robert Gagne's conditions of learning theory (1985). The theory focuses on intentional or purposeful learning outcomes and the events of instruction which provides a framework for learning conditions. He believed that events in the learning environment influence the learning process. Gagne relates learning outcomes to the events of instruction. He gives a systematic statement of theory to illustrate the way instructional events are designed for each of the learning capabilities or learning outcomes. Gagne describes two different types of conditions that exist in learning which are internal and external. External conditions include different stimulus that are outside the learner such as environment. Gagne's theory suggests that successful learning and improved mathematical performance can stem from both internal and external influences. In context of this study, this theory could help in understanding how learning environment factors influence the learning of Mathematics

2.2 Learning Environment and Learners' Academic Achievement in Mathematics

Learning Environment factors in a school are the internal conditions of the school that affects learners' academic achievement. These include physical, psychological, and emotional potentials of learners. Many students fail to develop universally their potential because of inadequacy on learning environmental stimulation (Henderson, & Cunningham, 2023). Also, a study done by Mahoney et al., (2021) noted that staff office, classroom space for learners represented the major areas that largely influence academic achievement of learners in public schools. The physical environment may encompass climate conditions like temperature, precipitation, and wind. According to analysis done by Gündoğdu and Ali (2022), temperature and air quantity are essential entities in school's environment which affects learners in arid and semi-arid areas (ASAL) where temperatures are usually very high. The climatic conditions interact with the physical infrastructure in school to determine the student comfort. High temperatures and lack of air circulation makes learners sleepy and lack concentration on their studies, they further noted that academic achievement in the ASAL regions has been significantly below the required standards due to harsh climate conditions making learners to disrupt classes in afternoon (Mora et al., 2025). Climatic conditions are significant condition in according to learners with a nice conducive support for learning.

Sermon, (2020) suggested that technology has the potential to transform leaning environment from passive to active and more after the control of the learners. Irvan, I. (2024) pointed out that teachers ought to integrate teaching media when teaching to enhance teaching and learning experience. The social environment refers to the relationship dynamics among students, teachers, school administrators, parents and other stakeholders (Rusticus et al., 2023). The interaction between stakeholders shapes the learning atmosphere in a school. Positive interactions promote cooperation, inclusivity, respect, and sense of belonging leading to enhanced learning outcome. The study by Gutierrez and Doronio (2024) found secondary school students in Phillipines were highly engaged with Mathematics where the classroom social environment was favourable in terms of teacher providing support and mutual respect. The study revealed that the classroom social environment was greater determinant of students' engagement with mathematics than setting of performance goals. The study emphasizes the importance of better teacher-student interaction typified by recognition of students' accomplishment, creation of friendly learning environments and provision of constructive criticism.

A study by Lubis et al. (2022) noted that in some environment where there is no security there have been no

appropriate learning, students become uneasy to learn and lack concentration in class because of disturbances due to presence of police officers in tracks and helicopters patrolling the area to give security. The cultural environment encompasses school values, norms and expectations that shape the behaviours and experiences of students, teachers, and other stakeholders (Rusticus et al., 2023). Positive school cultures that emphasize excellence and high performance often lead to better learning outcomes than negative school cultures that tend to promote lack of enthusiasm. The study by Liu et al. (2022) established that schools that had cultures that establish line of authority and enforce a strict disciplinary climate tend to promote effective learning. Research has shown that student's perception of school climate significantly explains physiological identification with the school. Perry, M.M (2023), also indicates that school climate and discipline such as bullying is related to school safety and achievements. This implies that there is a link between the school social and cultural environment and that both interact to shape students' achievement. In Tanzania, Begenyeza et al. (2021) found that there was an association between school culture and students' attitude towards the learning of Mathematic. It was observed that schools whose teachers encouraged students, provide feedback to student, and use alternative instructional methods like study recorded positive attitude towards learning of mathematics among students. Positive attitude is likely to translate to better performance. In Kenya, Mugo et al. (2024) examined the effect of school culture on the performance of secondary schools' students in Laikipia North and Nyahururu Sub-Counties in the Mathematics subject. Results showed most of the secondary schools were characterized by culture that emphasizes frequent assessment of students, optimal scheduling of Mathematic classes, and motivating students on the mathematics. This culture was positively associated with Mathematic performance among students. Njoroge et al. (2024) further observed that public secondary schools in Nyandarua County whose culture emphasized instructional supervision and optimal evaluation of learning outcomes recorded better performance in Mathematics than their counterparts. These studies highlight the school culture is an important determinant of Mathematic achievement even in the African context.

2.3 Gap in the Literature

The literature on learning environment factors highlights how physical settings, classroom atmosphere, teacher-student relationships, and available resources impact student learning outcomes. Many studies typically focus on mainstream education settings, leaving a gap in understanding how learning environment affect students with special needs or those from marginalized backgrounds. These gaps suggest a need for more integrated and context-sensitive research that considers both the tangible and intangible elements of learning environments across diverse student populations.

3. Methodology

The study adopted descriptive research design. Ahmad and Febryanti, (2018) recommend the use of descriptive design when investigating people's attitudes and views as they are without manipulating the variables. The secondary schools' principals, Mathematics teachers and students described the environment factors affecting academic achievement in mathematics. This study was carried out in Marigat sub county of Baringo County, Kenya. It is a semi-arid area that lies 1067 metres above sea level within the latitude of 0.467 and longitude of 35.983. The study targeted 18 public mixed day secondary schools comprising of 18 principals, 44 mathematics teachers and 554 form four learners because they have stayed longer in school and, hence having experience. The study sampled respondents from 12 public mixed day secondary schools that was purposively selected because they have been presenting KCSE candidates from Year 2019-2023 hence have relevant experience and data. The respondents were 156 comprising of 12 principals, 24 teachers and 120 students. The instruments for gathering data for this study included questionnaires, interviews, and document analysis. Reliability of research instruments was ensured by using test and re-test methods where the questionnaire for teachers had a reliability coefficient of 0.791 while the questionnaire for students had a reliability coefficient of 0.812. An introduction letter from Bomet University was obtained before data collection. Similarly, research permit was obtained from the Kenya National Commission for Science, Technology, and Innovation (NACOSTI). The research team coded Data and entered to a computer for statistical analysis, where Statistical Package for Social Science (SPSS) software was utilized for analysis. Descriptive and inferential data analysis techniques were used to analyse the collected data.

4. Results and Discussions of findings

Demographic data was collected on gender and age. The sample was evenly distributed in terms of gender with male and female students' constituting 50% of the sample each. Most of the students (86.7%) were in the 16-20 years age brackets. Three-quarters of the sampled teachers 18 (75%) were male while the remaining 6(25%) were female. In terms of age, 16 (66.7%) of the teachers were below the age of 40 years, 7 (29%) were between 41 and 50 years, and 1 (4.2%) were above 50 years. Regarding the number of years worked in the sampled schools, 13 (54.2%) had worked for 1-5 years, 8 (33.3%) had worked or 6-10 years, and 3 (12.5%) had worked for over 10 years. Academic achievement in mathematics was the dependent variable of the study. This variable was measured using the mean grades obtained by the sampled schools in the KCSE in the year 2023. The KNEC grades subject scores in the KCSE examination on a twelve-point scale, with 12 being the highest point and 1 being the lowest. The researcher then computed the aggregate mean points for the scores given by each teacher. Table 2 summarizes aggregate mean points for the scores in KCSE.

Table 2: Academic Achievement in Mathematics in the Sampled Schools

Statistic		Value
N	Valid	12
	Missing	0
Mean		1.662
Minimum		1.364
Maximum		2.352

Source: Field Data (2024)

Table 2 shows that the sampled school had aggregate mean points of 1.662 in mathematics in 2023. This implies that on average, most students who did their KCSE in the sampled school in 2023 scored a D- in mathematics. The points are lower than the average points for Baringo County for the last five years, which stood at 2.97. Table 2 further reveals that the best performing school within the sample had aggregate mean points of 2.352 while the worst performing school had an aggregate mean of 1.364 in the 2024 KCSE examinations. The overarching conclusion drawn from the data is one indicating a concerning level of mathematical achievement within the context of the sampled school particularly when compared with regional performance. The lower performance levels in Marigat Sub-County's mixed-day public secondary schools signal a systemic issue that requires attention. This variance points towards existence of school factors that distinguishes the performance of one school from the other. Figure 1 presents a breakdown of the achievement of each of the 12 sampled schools in 2023 KCSE examination.

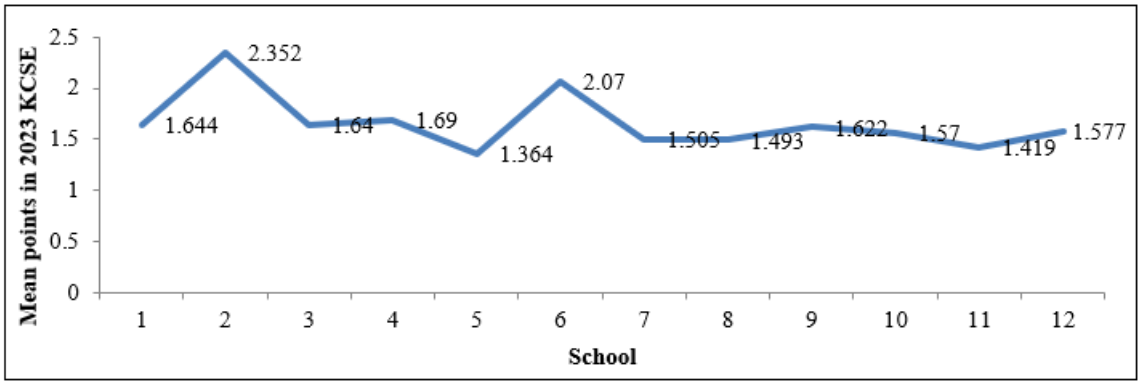


Figure 1: Trends in the Mathematics Achievement across the Sampled Schools

Source: Field Data (2024)

Figure 1 shows that all the mathematics mean points of most of the schools fell between 1 and 2, suggesting that most students scored D- and E grades. In fact, only school 2 had mean point that was greater than 2 in the 2023 KCSE. The objective of the study was to establish the effect of learning environment factors on academic achievement in mathematics in public mixed day secondary schools in Marigat sub-county. The questionnaires contained a list of five items that students and teachers' rate on five-point scale. Table 3 summarizes the results.

Table 3: Teachers' and Students views on Learning Environment Factors

S/N	Statement	Respondent	5	4	3	2	1	Mean	SD
1	There are enough teaching and learning facilities in the school such as classroom, library which enhance learning.	Teacher	16.7	29.2	20.8	20.8	12.5	3.17	1.308
		Student	36.7	25.8	23.3	8.3	5.8	3.79	1.194
2	The harsh climatic conditions such as high temperature interrupt afternoon lessons.	Teacher	29.2	37.5	25.0	0.0	8.3	3.79	1.141
		Student	51.7	17.5	16.7	5.0	9.2	2.02	1.312
3	My school is safe and conducive for learning and teaching	Teacher	41.7	33.3	20.8	4.2	0.0	4.13	0.900
		Student	50.0	18.3	20.8	7.5	3.3	4.04	1.148
4	In my school, student and teachers trust one another and work towards common interest.	Teacher	16.7	20.8	58.3	0.0	4.2	3.46	0.932
		Student	33.3	20.0	14.2	9.2	23.3	3.31	1.576
5	The school has a culture that encourages diversity and celebrates achievement, which has improved performance in mathematics	Teacher	12.5	20.8	16.7	25.0	25.0	2.71	1.398
		Student	20.8	15.0	18.3	14.2	31.7	2.79	1.539

Source: Field Data (2024)

Table 3 shows that 4, (16.7%) of the sampled teachers agreed strongly, 7(29.2%) agreed, 5(20.8%) agreed a little, 5(20.8%) disagreed, and 3(12.5%) strongly disagreed that there are enough teaching and learning facilities in the school such as classroom, library which enhance learning. Similarly, 44(36.7%) of sampled students agreed strongly, 31(25.8%) agreed, 28(23.3%) agreed a little, 10(8.3%) disagreed, and 7(5.8%) strongly disagreed with this claim. The findings show a consistency between the views of teachers and students regarding teaching and learning facilities within the schools. These findings imply that most public co-educational schools in Marigat Sub-County have adequate teaching and learning facilities. The findings contradict the study by Simiyu, Burajmoh and Davidson (2021), who found that most public co-educational secondary schools lacked functional libraries, and many of the available ones were poorly resourced.

On the other hand, 7(29.2%) of the sampled teachers agreed strongly, 9(37.5%) agreed, 6(25.0%) agreed a little, and 2(8.3%) strongly disagreed with the claim that the harsh climatic conditions such as high temperature interrupt afternoon lessons. Students expressed almost similar views with 62(51.7%) agreeing strongly, 4(17.5%) agreeing, 4(16.7%) agreeing a little, 2(5.0%) disagreeing and 2(9.2%) disagreeing strongly with this statement. These data indicate that harsh afternoon heat frequently disrupts lessons in most Marigat mixed-day schools. These findings are congruent with a study by Kithikii, A. K. (2023), which revealed that droughts were a major cause of school closures, particularly in regions where water is scarce. In some cases, schools were

forced to close for several weeks or even months, causing students to fall behind and lose motivation.

Then again, 10(41.7%) of the sampled teachers agreed strongly, 8(33.3%) agreed, 5(20.8%) agreed a little, and 1(4.2%) disagreed that their school was safe and conducive for learning and teaching. Students' views were not far off because 12(50%) strongly agreed, 22(18.3%) agreed, 25(20.8%) agreed to a little extent, 9(7.5%) disagreed and4 (3.3%) disagreed strongly with the assertion that their schools were safe. These findings suggest that insecurity is not a major hindrance to learning in most public mixed day secondary schools in Marigat Sub-County. The findings contradict a study by KNEC and TSC (2019), where it was reported that insecurity incidents, such as bandit attacks and cattle rustling, pose a significant threat to education in Baringo County. The inconsistency may be explained by the reason that the insecurity experienced in the larger Baringo County is not prevalent in Marigat. It is also probable that the security situation in Baringo has changed since the studies by KNEC and TSC were conducted in 2019.

Moreover, 4(16.7%) of the sampled teachers agreed strongly, 5(20.8%) agreed, 14(58.3%) agreed a little, and 10 (4.2%) disagreed strongly that in their school, students and teachers trust one another and work towards common interest. Similarly, 39 33.3% of sampled students agreed strongly, 24(20.0%) agreed, 17(14.2%) agreed a little, 11 (9.2%) disagreed, and 28 (23.3%) disagreed strongly with the statement that there is trust between teachers and students. This implies that there is trust between students and teachers in most public mixed day secondary schools in Marigat. These findings are not congruent with Kamau L. (2022), who found that there was a significant level of distrust between students and teachers in Kenyan secondary schools. The study revealed that students perceived teachers as unfair, biased, and not transparent in their dealings. There was also a general feeling among students that teachers did not act in their best interests. However, Paschal & Mkulu (2023) discovered that the level of trust between students and teachers varied significantly depending on teacher-student interactions and communication. This could explain why the findings of the current study differ with those of (Kamau L. 2022).

Lastly, 3(12.5%) of the teachers agreed strongly, 5 (20.8%) agreed, 4(16.7%) agreed a little, 6(25.0%) disagreed, and another 6(25%) strongly disagreed that their school had a culture that encourages diversity and celebrates achievement, which has improved performance in mathematics. Similarly, 25(20.8%) of the sampled students agreed strongly, 18 (15.0%) agreed, 22 (18.3%) agreed a little, 17(14.2%) disagreed, and 38 (31.7%) strongly disagreed with the statement on culture. The total proportion of teachers and students who agreed with this statement was 1250% and 6454.1% respectively, which is an indication that close to half of the teachers and students did not agree. These statistics imply that there were major variations in the culture of the schools with about half of the schools exhibiting a culture that encourages diversity and celebrates achievement while the other half does not. Unlike teachers and students, principals involved in the interviews believed that there is inadequate infrastructure in the schools and that insecurity is also a problem in Marigat. Six out of the twelve principals (50%) mentioned insecurity and inadequate facilities to be among the learning environment factors contributing to poor academic achievement in mathematics. Five out of the twelve principals (41.7%) reinforced the teachers' position that harsh climatic conditions particularly hot temperatures were hampering learning contributing to poor academic achievement in mathematics within the school.

The data collected from students using Likert scale was converted to continuous data to facilitate the use of Pearson correlation method. The null hypothesis, H_{01}, stated as:

H_{01}: Learning environmental factors have no statistically significant effect on academic achievement in mathematics in public mixed day secondary schools in Marigat sub-county.

This hypothesis was tested inferentially using bivariate Pearson's correlation in order to determine the direction and strength of association between the two variables in question. Results were as presented in Table 4

Table 4: Correlation between Learning Environment Factors and Mathematics Achievement

		Mathematics achievement
Learning environment factors	Pearson Correlation	.054
	Sig. (2-tailed)	.560
	N	120

α = .05

Source: Field Data (2024)

As noted in Table 4, there is a weak positive association between learning environment factors and mathematics achievement [r= .054, p= .560 at α= .05]. The association between the two variables was non-significant. The null hypothesis was therefore affirmed.

To further interrogate the effect of learning environment factors on academic achievement in mathematics among learners, data of the learning environmental factors was regressed against data on learners' achievement in mathematics. Results revealed that learning environmental factors did not have a statistically significant effect academic achievement in mathematics [t= 1.514, β= .056. p>0.05]. These results meant that the null hypothesis of the study, which stated that *learning environmental factors have no statistically significant effect on academic achievement in mathematics in public mixed day secondary schools in Marigat sub-county* was affirmed.

5. Conclusion

Based on the findings, the study concludes that learning environment factors do not have a statistically significant effect on academic achievement in mathematics. Despite the established importance of a positive and supportive learning environment in fostering student engagement and motivation, the analysis indicates that these factors alone do not directly translate into improved academic performance in mathematics. This finding suggests that while aspects such as classroom climate, physical space, and peer interactions may influence other areas of student development, their

direct impact on mathematics achievement may be weaker than anticipated. It underscores the need for a more nuanced understanding of how environment factors interact with other educational elements, such as curriculum implementation and teacher quality, to collectively shape academic outcomes.

6. Recommendation

Educators and policy makers should not concentrate much on improving physical learning environments but instead concentrate on allocating scarce resources towards the most effective levers of mathematics improvement in Marigat Sub County Schools.

7. Future Scope

This study did not address all the gaps which were realized. It's therefore imperative that further research should be carried out in other related areas for instance the effects of gender dynamics, school leadership, and parental involvement on shaping student attitudes and performance in mathematics, particularly in mixed-gender environments. Gaining a deeper understanding of these intricate interactions can inform the creation of context-sensitive interventions aimed at enhancing educational equity and learning outcomes in remote secondary schools.

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