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RESEARCH ARTICLE

ACTUALIZATION OF COMPETENCY BASED CURRICULUM: INFLUENCE OF SCHOOLS' PHYSICAL ENVIRONMENT ON ATTAINMENT OF LEARNING OUTCOMES IN KENYA

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Abstract

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The quality of the internal physical environment of a school is critical in enhancing the achievement of learning outcomes and therefore the actualization of competency based curriculum in schools. The main objective of this study was to establish the relationship between the internal schools' physical environment and student achievement in public secondary schools in Nairobi City County. The purpose of the study was to assess the influence of the internal environment of schools on the attainment of learning outcomes. The study sought to empirically fill the knowledge gap of establishing the strength of correlation between schools' internal environment and learning outcomes. The study employed ex facto research design targeting a population of 75(N) public secondary schools. Using stratified, systematic and simple random sampling techniques, the study drew a sample size of 39 (n) schools from the study population. A revised Commonwealth Association of Physical Environment (CAPE) questionnaire was used to collect data for the study. The study revealed that the school environment influenced the learners' achievement as manifested in the test scores; (Pearson's r, there was a positive correlation between the school environment and student achievement; $r = 0.370$, $n = 35$, $p = 0.029$). The study concluded that school physical environment contributes to student achievement. A framework of redesigning school facilities was therefore suggested with key features of; cost effectively upgrading old facilities, improving school grounds and controlling physical development around educational facilities.

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Introduction:-

Background to the Study:

The Dakar Framework for Action (UNESCO, 2000) argues that socio-economic progress, durable peace and sustainable development for the African people will hinge on the success of their education systems. Part of the strategy to achieve this vision in Africa is to devote attention to the development of social learning environments that are feasible and sustainable in the local setting of the African learner. UNESCO argues that learning environments must be safe and intellectually stimulating. They must also have a pedagogy based on a learner-centered approach, democratic values and best practices in the teaching-learning interactions.

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The adoption of the Competency Based Curriculum (CBC) in Kenya was informed by various policy documents such as Kenya Vision 2030, Constitution of Kenya 2010, the Task Force report on the Re-alignment of the Education Sector to the 2010 new constitution dispensation, the Sessional Paper No. 2 of 2015 on 'Reforming Education and Training, the sustainable development goals, and the KICD needs assessment report 2016 among other documents (KICD, 2017). In response to the need to implement CBC, the Nairobi Integrated Urban Development Master Plan (NIUPLAN) 2014-2030 adopted in toto this vision of the national government into its educational development framework. NIUPLAN is a collaboration between the Japanese International Cooperation Agency and Nairobi City County, which embraces an evolving urban policy regime in integrating socio economic environmental and political issues under one framework thereby providing an order of physical investments and has an ambitious proposal to build an additional 77 public secondary schools to serve the residents of Nairobi.

The impact of the above policy declarations on academic achievement remained unexplored over the years, most particularly the physical infrastructure aspects. How the physical environments impact on achievement and the expected policy statements declarations remain scanty, especially in Kenya (Anyon, 2014).

Literature Review:-

Lighting Conditions and Student Achievement:

Research indicates that lighting exerts a profound biological effect on humans. In addition to providing visual stimulus, light serves as a timer for biological rhythms. Kleiber, Music and Jayson (1973) found individuals experience less fatigue in naturally lit environments than in a traditionally illuminated university setting. A study was conducted in which students' lighting level preferences were compared to performance. Students were exposed to extremely bright light and then to an extremely dim environment. Scores on both reading speed and accuracy were significantly higher in illuminated instructional environments. A variety of well-lit and dimly lit environments should be provided for students (Dunn, Krimsky, Murray and Quinn, 1985). Benefits of natural light include increased human productivity and performance (Boye, Hunter and Howlett, 2003). Good lighting also prevents the occurrence of myopia (Grangaard, 2003), systemizes bodily processes (Djik and Cajochen, 1997) and is critical for Vitamin D production (Veitch and McColl, 2001).

Thermal Conditions and Student Achievement:

Task performance, attention span and comfort levels are influenced by the thermal conditions of a place. Harner (1974) found that reading and mathematical skills were adversely affected by temperatures above 74°F. Thermal conditions below optimum levels affect dexterity, while higher temperatures decrease general alertness and increase physiological stress. Friendly thermal environments have been shown to increase performance in business and industrial premises (Osborne and Vernon, 1922; McConnell and Yaglou, 1926; Winslow and Herrington, 1949), where a long history of research exists. Research on how thermal conditions affect student performance is worth investigating. Comparisons to the performance in workplace set-ups can then be made.

Wyon (1991) showed that student performance at mental tasks is affected by changes in temperature, and Fang et al. (1998) found that office workers are most comfortable in the lower end of temperature and humidity comfort zones. These findings support the idea that students will perform mental tasks best in rooms kept at moderate humidity levels of between 40% and 70% and moderate temperatures in the range of 68°F to 74°F.

Indoor Air Quality and Student Achievement:

Indoor air quality (IAQ) is a function of particles within and around buildings, especially as it relates to the health and comfort of building occupants. Indoor air pollutants can be from natural or anthropogenic materials. Indoor sources of pollutants include small pools of water in the heating, ventilation or air conditioning systems. Outdoor air pollutants are also brought indoors via the ventilation system (Czubaj, 2002).

Poor indoor air quality can disrupt learning among students and cause a number of health problems. These include upper respiratory infections, nausea, skin rashes, dizziness, headaches, mental fatigue or sleepiness and irritation of the eyes, nose and throat. Collectively, these effects are referred to as sick building syndrome (EPA, 2000). Burning of grass, paper and other forms of waste is known to pollute the air. Poor liquid and solid waste disposal is another cause of poor IAQ. Exposure to mould and bacterial contaminants also has negative health effects.

Good ventilation helps dilute air pollutants that can accumulate inside buildings. Such pollutants come from breathing, skin particles, cloth fibres, perfumes, shampoos and deodorants; from building materials and cleaning agents, paint fumes and pathogens. In sufficient concentrations, they become harmful.

The first symptom of poor IAQ is the buildup of carbon dioxide. When the carbon dioxide level in a given area reaches 1,000 parts per million, which is about three times what is normally found in the atmosphere, headaches, drowsiness and inability to concentrate ensue. The principal source of fresh air is windows. The size of windows and the building orientation to prevailing winds can substantially ventilate school buildings. Ducted systems as additional methods for ventilating school buildings have had mixed success. This is because lack of specific knowledge makes it difficult for policy makers to create definitive IAQ standards.

The logic is that sick students and teachers cannot perform as well as healthy ones (EPA, 2000; McGowen, 2007; Leach 1997). Most notably, poor IAQ has been associated with increased student absenteeism. Improving IAQ through air cleaning technology reduces absenteeism thereby improving student achievement (Rosen and Richardson, 1999).

School Size and Student Achievement:

McGowen (2007) noted that as enrolment numbers climb, the issue of school size becomes relevant to the task of improving student performance. A case in point was the Columbine disaster in 1999. With a large enrolment of 1,870 students, teachers found it increasingly difficult to attend to individual students.

Small schools offer students greater opportunities to participate in co-curricular activities and to exercise leadership roles. Smaller schools of below 500 students have lower incidences of crime and misconduct (Garbarino, 1980). In a review of the relationship between school size and academic achievement, Fowler (1992) found that there is a negative relationship between Maths and verbal ability tests.

Class Size and Student Achievement:

Class size research points directly to a social and physical link to student achievement. In the longitudinal research represented by the Tennessee Student-Teacher Area Ratio (STAR) project and the Lasting Benefits Study (LBS), children were followed from kindergarten through to 3^{rd} grade (Achilles, 1992; Finn and Achilles, 1990). Children from smaller classes, of 13 to 17 students per room, outperformed those from regular size classes, of 22 to 25 students per room, as measured by test scores on the Stanford Achievement Test. No explicit explanations were given. One possible reason is that in addition to the higher number of student-teacher interactions possible in smaller classes, spatial density and crowding are also reduced. Crowding can induce stress thereby increasing aggressive behaviour and levels of distraction in children. In smaller classes student engagement and participation is increased and students are thus likely to have fewer disciplinary problems.

Schools in Community and Student Achievement:

Schooling can be the icon of a community heritage and a celebration of its culture (Malone, 2001). Building designs and construction materials reflect the history and makeup of the area that a school serves. School architecture may symbolize what is important to the community and the leaders therein (Cutler, 1989). For instance a school with a large gymnasium and a small library may send a message that sports are more important than academic endeavors.

Principles of sustainable school design benefit the communities in which they are embedded. The school-community interaction can positively affect the performance of students if the relationship is amicable. Negative influences can occur as a result of the community providing a ground for drug and alcohol abuse. Distractions like noise and air pollution can emanate from the community.

Acoustic Quality and Student Achievement:

Prolonged exposure to loud noise is often harmful to the mental and psychological well-being of individuals. Noise in the learning environment may come from either within or without the school setting. A significant increase in blood pressure was noted in schools near urban streets (Evans et al, 1991). Abnormally high blood pressure in students has been found among children residing near airports (Berglund and Lindvall, 1986). Exposure to traffic noise has been linked to deficits in mental concentration, making errors on simple tasks, and the greater likelihood of giving up on tasks before the time allocated has expired. Ongoing construction in schools or other major construction works outside the learning environment are sources of noise that interfere with the teaching-learning

process; teachers have to continually pause for the noise to subside. School sites and building locations should take cognizance of the impact of noise on the learning process.
The monthly averages of outdoor noise levels for different schools in Cairo, Egypt range from 43.3 decibels to 74.35 decibels (Table 1.0). These schools are located in different areas, some along main roads and others in residential areas, with workshops and commercial activities. The measurements show that all these schools suffered from the outdoor noise, where the average monthly outdoor noise levels for the majority of schools exceeded the permissible limits by approximately 13 to 18 decibels during the day.

Table 1.0:- Average indoor noise for different schools in Cairo, Egypt.

			Noise levels in Decibels		
Name of School	**Type of Building**	**School Location**	**Laq**	**Lmax**	**Lmin**
Sakr Parish School	Modern	On main road	60.3	74.4	55.5
Fouad Gala School	Modern	On main road	60.2	73.4	53.4
El-Nokrashy School	Modern	On main road	60.5	71.8	54.2
Hadaek Shoubra School	Modern	In residential areas with workshops and commercial activities	61.8	74.2	54.2
EsmailElkabani School	Old		59.7	72.5	52.8
Philistine Primary School	Modern		58.3	72	49.7
El-Bahaya School	Old	In residential area in the city	55.4	67.4	46.1
Faculty of Girls School	Old		54.8	65.4	43.3
Foad Galal School	Modern		53.9	64.7	47.4

Source: https://www.ismaisaac.be/past/conf/isma2010/proceedings/papers/isma2010_0564.pdf

In Ismail-Elkabany and El-Bahaya Secondary Schools, the outdoor noise exceeded the permissible limit by about 15 decibels. This was due to the location of the school near a highway with heavy traffic and all types of vehicles (Kamal et al, 2010). Schools should bear the costs associated with reducing noise levels whose sources they may have no control over

Building Age and Student Achievement:

Burkett (1982) found that students in newer buildings outperformed those in older ones and posted better records for health, attendance and discipline. Similar academic improvements in newer facilities have been noted (Phillips, 1997; Jago and Tanner, 1999). Earlier studies adopted the age of school buildings as a proxy for the quality of the physical environment. This assumption is not necessarily valid as newer buildings do not always have more modern technology and efficient conditions. Consequently, older schools are not automatically in worse condition than newer schools. In previous studies, school building age has been treated as an independent variable that indirectly influences student achievement with above standard building conditions being associated with higher student achievement (McGuffey & Brown, 1978; O'Donnell, 2016). However there are other characteristics of a school, beyond age, that reflect the quality of its environment. With time, older buildings are renovated or upgraded and are thus ‘newer’ and more efficient than recently built facilities.

Initial research into the relationship between student academic achievement and building condition focused on the impact of one physical condition variable such as age, colour or lighting on student achievement. But this approach is less favoured today than other research approaches emphasizing the relationship between total overall building condition and student achievement.

Building Condition, Facility Management and Student Achievement:

A well designed sustainable environment is a good starting point for measuring the quality of school facilities. However the best measure for the quality of a facility is that of the maintenance of its buildings. Buildings deteriorate with age and hence their quality over time is a function of the operation and the maintenance of the facility. Edwards (1991), in a correlation study of building condition and student achievement in the Washington DC schools, found that poor building conditions were hampering student performance, and estimated that improved facilities could lead to a 5.5% to 11% improvement in standardized tests.

Purpose and objectiveof the study:
The purpose of this study was to explore the relationship between the physical environment and academic results in public schools in Nairobi City County. The objective of the study was to establish whether there was a relationship between the physical environment and academic achievement of learners.

Research Design and Methodology:
The study adopted ex facto research design. Public secondary schools were stratified into boys, girls and mixed categories. These were further stratified along eight geopolitical divisions in Nairobi County. Schools were proportionally allocated to the divisions. Systematic and simple random sampling techniques were employed to select the 36 schools investigated by the study. A revised Commonwealth Association of Physical Environment questionnaire, an interview schedule and an observation were used to collect the data for the study..

Study findings and discussion:
Relationship between School Environment and Mean Grade:
The results indicate that there was a positive relationship between the external environment and mean grade in 2011; r = 0.370, n = 35, p = 0.029. There was also a positive relationship between the neighbouring environment and overall school quality; r = 0.451, n = 35, p = 0.007. There was no correlation between the overall school quality and mean grade; r = -0.118, n = 35, p = 0.5. There was no correlation between the internal environment and mean grade; r = 0.110, n = 35, p = 0.530. Finally there was no correlation between the neighbouring environment and mean grade; r = 0.068, n = 35, p = 0.698 (Table 1.1).

Table 1.1:- Relationship between internal environment and mean grade in 2011.

		Mean Grade 2011
Mean Grade 2011	Pearson	1
	Sig. (2-tailed)	
	N	35
Internal Environment	Pearson	0.11
	Sig. (2-tailed)	0.53
	N	35

There was no correlation between the internal environment and mean grade; r = 0.079, n = 35, p = 0.652 (Table 1.2).

Table 1.2:- Relationship between internal and mean grade in 2010.

		Mean Grade 2010	Internal
Mean Grade 2010	Pearson	1	0.079
	Sig. (2-tailed)		0.652
	N	35	35
Internal Environment	Pearson	0.079	1
	Sig. (2-tailed)	0.652	
	N	35	35

There was also a positive relationship between the neighbouring environment and internal environment; r = 0.415, n = 32, p = 0.018.
There was no correlation between the internal environment and mean grade; r = 0.079, n = 35, p = 0.652.

Similar studies have been undertaken in other parts of the world. McGuffey and Brown (1978) investigated the influence of school building age on student achievement in the 4th, 8th, and 11th grades in Georgia. There was a positive relationship between facility age and what students learn, and this relationship was not related to the socio-economic status (SES). The study used the Iowa Test of Basic Skills for the 4th and 8th grade students and the Test of Academic Progress for the 11th grade students.

Table 1.3:- Relationship between internal, external and mean grade in 2009.

		Mean Grade 2009	Overall	Internal
Mean Grade 2009	Pearson	1	0.259	0.079
	Sig. (2-		0.133	0.652

	tailed)			
	N	35	35	35
Overall School Quality	Pearson	0.259	1	0.099
	Sig. (2-tailed)	0.133		0.571
	N	35	35	35
Internal Environment	Pearson	0.079	0.099	1
	Sig. (2-tailed)	0.652	0.571	
	N	35	35	35

Studies in which schools were categorized as having old non-modernized buildings, partially modernized buildings or modernized buildings have been investigated. The study designs were ex post facto, meaning that non-experimental research was done after the conditions to be studied had occurred. There is a post-test, but no pre-test. Different statistical analyses, multiple regression, step-wise regression, t-test, f-test, and the ANOVA were used to analyze data. A significant relationship was found between facility age and student achievement (Chan, 1979; Garett, 1980; Plumley, 1978).

Philips (1997) studied the relationship between the age of school facilities and the academic achievement of students taught in both old and new facilities. He used a pre-test/post-test control group and 3 statistical analyses. First, an analysis of covariance (ANCOVA) was adopted as a way to control the differences on the pre-test. Secondly, Pearson's r made it possible for a significant relationship between student reading and Mathematics scores and the number of student absences to be found. Lastly, one-way ANOVA was used to determine whether there were significant differences in student scores in reading and Mathematics between and within groups. Philips concluded that the age of school facility can be either a positive or a negative motivator to student attendance and learning.

Duke (1998) noted that students can excel in spite of obstacles imposed by settings. It is reasonable, though, to want to know which settings maximize student performance. Bowers and Burkett (1987) examined the relationship between the school environment settings and student achievement. They used ANOVA and t-test as their statistical design. A positive impact in the relationship was found by the research. Coleman et al. (1966) stated that schools do not a make a difference in student achievement. What makes the difference in academic achievement by students is their economic and social background (Lezotte and Passalacqua, 1978). However, when the socio-economic status (SES) is controlled, it has been found that schools make a difference on both student achievement and behaviour (Cash, 1993; Earthman, et al., 1996; Hines, 1996**;** Lanham, 1999**).**

Cash's (1993) study dealt with the overall building condition and its relationship to student achievement and behaviour. Building condition was determined using the Commonwealth Assessment of Physical Environment (CAPE) instrument. Achievement scores were adjusted for socio-economic status using the percentage of students in the free and reduced lunch programmes. The variables were investigated using the analysis of covariance, correlations and regression analysis. Cash found that student achievement scores were higher in schools with better building conditions.

Earthman et al (1996**)** conducted a study similar to Cash's 1993 study of North Dakota high schools. The building condition was measured using responses from principals' survey responses to the State Assessment of Facilities in Education (SAFE). The instrument had three categorical conditions: overall building condition, structural building condition and cosmetic building condition. The results indicated a positive relationship between overall building condition and student achievement.

Lanham (1999) replicated Cash's study. However, he modified Cash's model by adding one factor, deferred maintenance, which he predicted would negatively affect building and classroom conditions. The facilities were investigated using an Assessment of Building and Classroom Conditions. Two statistical analyses were used. Pearson's r was used to find out the interrelationships among various independent variables that were the items listed in the building assessment instrument. A five-step multiple regression analysis was used to help identify the relationship between the identified dependent and two or more predictor variables.

Al-Enezi (2002) undertook a study seeking to find the relationship between building condition and student achievement in Kuwait. He argued that ethics, accountability, leadership style, power and knowledge influenced perceptions of the school building. These perceptions affected how maintenance staff carried out their duties. Kuwaiti Ministry of Education funding decisions played a critical role in facility maintenance. He found a positive relationship between performance and school building condition.

The findings of the study confirm what has been found elsewhere; that the school physical environment affects student achievement

Difference in the Relationship between School Environment and Achievement among Boys', Girls' and Mixed Schools

In 2011, the type of school had a significant effect on the differences noted in the impact of the overall environment rating on student achievement; $F (2, 26) = 31.972$, $p < 0.001$. The overall school quality affected significantly the differences in achievement among boys', girls' and mixed schools; $F (18, 26) = 20.073$, $p = 0.001$. The interaction of the overall school quality and type of school also affected the differences in performance; $F (5, 6) = 10.885$, $p < 0.006$ (Table 1.4).

Table 1.4:- ANOVA in 2011 for overall environment and type of school.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7249.875[a]	25	289.995	26.335	0	0.991
Intercept	49235.48	1	49235.48	4471.214	0	0.999
Type of school	704.125	2	352.062	31.972	0.001	0.914
Overall school quality	3978.728	18	221.04	20.073	0.001	0.984
Type of school * Overall school quality	599.312	5	119.862	10.885	0.006	0.901
Error	66.07	6	11.012			
Total	61761.82	32				
Corrected Total	7315.945	31				
a. R Squared = .991 (Adjusted R Squared = .953)						
Tests of Between-Subjects Effects						
Dependent Variable: mean grade 2011						

In 2011, the type of school had a significant effect on the differences noted in the impact of school internal environment rating on student achievement; $F (2, 7) = 12.049$, $p < 0.005$. The internal school environment did not affect the differences in achievement among boys', girls' and mixed schools; $F (16, 7) = 2.441$, $p = 0.118$. The interaction of the internal environment and type of school did not affect the differences in performance; $F (6, 7) = 4.178$, $p < 0.042$ (Table 1.5).

Table 1.5:- ANOVA in 2011 for internal environment and type of school.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6844.901[a]	24	285.204	4.238	0.028	0.936
Intercept	45930.29	1	45930.29	682.552	0	0.99
Type of school	1621.582	2	810.792	12.049	0.005	0.775
Internal environment	2627.964	16	164.248	2.441	0.118	0.848
Type of school * Internal environment	1686.874	6	281.146	4.178	0.042	0.782
Error	471.044	7	67.292			
Total	61761.82	32				
Corrected Total	7315.945	31				
a. R Squared = .936 (Adjusted R Squared = .715)						
Tests of Between-Subjects Effects						
Dependent Variable: mean grade 2011						

In 2010, the type of school had a significant effect on the differences noted in the impact of school internal environment rating on student achievement; $F (2, 4) = 7.24$, $p < 0.047$. The internal school environment did not affect the differences in achievement among boys', girls' and mixed schools; $F (16, 4) = 2.093$, $p = 0.248$. The interaction of the internal environment and type of school did not affect the differences in performance; $F (6, 4) = 3.926$, $p < 0.103$ (Table 1.6).

Table 1.6:- ANOVA in 2010 for internal environment and type of school.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5892.944[a]	24	245.539	3.494	0.116	0.954
Intercept	41621.15	1	41621.15	592.311	0	0.993
Type of school	1017.566	2	508.783	7.24	0.047	0.784
Internal environment	2353.646	16	147.103	2.093	0.248	0.893
Type of school * Internal environment	1655.443	6	275.907	3.926	0.103	0.855
Error	281.076	4	70.269			
Total	54854.99	29				
Corrected Total	6174.021	28				

a. R Squared = .954 (Adjusted R Squared = .681)
Tests of Between-Subjects Effects
Dependent Variable: mean grade 2010

In 2009, the type of school had a significant effect on the differences noted in the impact of school internal environment rating on student achievement; $F (2, 6) = 12.799$, $p < 0.007$. The internal school environment affected the differences in achievement among boys', girls' and mixed schools; $F (16, 6) = 3.603$, $p = 0.061$. The interaction of the internal environment and type of school also affected the differences in performance; $F (6, 6) = 6.168$, $p < 0.022$ (Table 1.7).

Table 1.7:- ANOVA in 2009 for internal environment and type of school.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6825.570[a]	24	284.399	5.71	0.019	0.958
Intercept	44804.1	1	44804.1	899.513	0	0.993
Type of school	1274.976	2	637.488	12.799	0.007	0.81
Internal environment	2871.241	16	179.453	3.603	0.061	0.906
Type of school * Internal environment	1843.445	6	307.241	6.168	0.022	0.86
Error	298.856	6	49.809			
Total	60217.45	31				
Corrected Total	7124.426	30				

a. R Squared = .958 (Adjusted R Squared = .790)
Tests of Between-Subjects Effects
Dependent Variable: mean grade 2009

Enezi (2002) investigated whether the relationship between building condition and student achievement differed between boys' and girls' schools in Kuwait. He used a two-way factorial ANOVA (ANOVA) to examine whether there was a statistical significant main effect for overall, structural and cosmetic conditions of buildings on student achievement. The main effect of building condition on student achievement was examined by comparing the student achievements of the top quartile and bottom quartiles to see if there was a significant difference in means between these two groups. Results yielded a significant main effect of overall building condition and structural and cosmetic conditions on most subjects in the Science Major. No significant effect of these conditions was found on subjects in the Arts Major. The findings by this study do not contradict Al-Enezi's findings in the sense that the overall quality of the school environment affects the difference in achievement among boys', girls' and mixed schools in 2009, 2010 and 2011. However the internal, external and neighbouring environments do not individually explain these differences as Al-Enezi's findings do.

The study, based on these relationships, reject the null hypothesis that there is no relationship between the physical environment and academic achievement in selected public secondary schools in Nairobi City.

Aspects of the Physical Environment that Predict Student Performance

This section investigates how much variance in performance is explained by the variables investigated.

Table 1.8:- R Square Values in 2011 for Boys' Schools.

		R	R Square	F	P
Internal Environment		0.502	0.252	2.7	0.139
df=1 (Regression), 8 (residual)					

The variable affecting student performance among boys in 2010 was the accounted for 19.7% variable at p = 0.199

Table 1.9:- R Square Values in 2010 for Boys' Schools.

		R	R Square	F	P
Internal Environment		0.444	0.197	1.959	0.199
df=1 (Regression), 8 (residual)					

in 2009, where the variable affecting student performance among boys accounted for 25% of the variance in the dependent variable at p = 0.141

Table 1.10:- R Square Values in 2009 for Boys' Schools.

		R	R Square	F	P
Internal Environment		0.5	0.25	2.672	0.141
df=1 (Regression), 8 (residual)					

However, this is different for girls' schools. There was no significant variable that accounted for the variance in the dependent variable of performance in the year 2011. The p value ranged from 0.303 to 0.946 (Table 4.37).

Table 1.11:- R Square Values in 2011 for Girls' Schools.

		R	R Square	F	P
Internal Environment		0.319	0.102	0.794	0.403
df=1 (Regression), 7 (residual)					

There was also no significant variable that accounted for the variance in the dependent variable of performance in the year 2010, with the p value ranging from 0.281 for the overall environment to 0.942 for the neighbouring environment (Table 4.38).

Table 1.12:- R Square Values in 2010 for Girls' Schools.

		R	R Square	F	P
Internal Environment		0.326	0.107	0.835	0.391
df=1 (Regression), 7 (residual)					

No significant variable was found to account for the variance in the dependent variable of performance in the year 2009 (Table 4.39). This means that there were other variables at play to explain the differences in the girls' schools.

Table 1.13:- R Square Values in 2009 for Girls' Schools.

		R	R Square	F	P
Internal Environment		0.291	0.084	0.646	0.448
df=1 (Regression), 7 (residual)					

The findings in girls' schools were also evident in mixed schools. There was no significant variable that accounted for the variance in the dependent variable of performance in 2011. The p values were consistently high. The lowest and highest p values were in the external and overall environments, with values of 0.785 and 0.924 respectively (Table 4.40).

Table 1.14:- R Square Values in 2011 for Mixed Schools.

		R	R Square	F	P
Internal Environment		0.069	0.005	0.062	0.807
df=1 (Regression), 13 (residual)					

There was no significant variable that accounted for the variance in the dependent variable of performance in 2010.

Table 1.15:- R Square Values in 2010 for Mixed Schools.

		R	R Square	F	P
Internal Environment		0.112	0.012	0.127	0.729
df=1 (Regression), 13 (residual)					

There was no significant variable that accounted for the variance in the dependent variable of performance in 2009. The p values were consistently high.

Table 1.16:- R Square Values in 2009 for Mixed Schools.

		R	R Square	F	P
Internal Environment		0.075	0.006	0.068	0.799
df=1 (Regression), 13 (residual)					

All the schools considered together, the results show that the environment was the significant factor. In 2011, it accounted for 1.2% of the variations in performance in the schools at p = 0.53

Table 1.17:- R Square Values in 2011 for All Schools.

		R	R Square	F	P
Internal Environment		0.11	0.012	0.403	0.53
df=1 (Regression), 32 (residual)					

In 2010, the environment accounted for 18% of the variations in performance in the schools at a p = 0.018 confidence level (Table 1.18). The internal, neighbouring and overall environments were not significant factors explaining variations in performance.

Table 1.18:- R Square Values in 2010 for All Schools.

		R	R Square	F	P
Internal Environment		0.136	0.018	0.565	0.458
df=1 (Regression), 32 (residual)					

A similar pattern is observed in 2009 in which the internal environment accounted for 1.7% of the variations in performance in the schools at a p = 0.463confidence level. The internal, neighbouring and overall environments were not significant factors explaining variations in performance (Table 1.19).

Table 1.20:- R Square Values in 2009 for All Schools.

		R	R Square	F	P
Internal Environment		0.3	0.017	0.551	0.463
df=1 (Regression), 32 (residual)					

The conclusion is that the environment fundamentally influences performance in public secondary schools in Nairobi City County. could include entry marks of students and adequacy of teachers which were beyond the scope of this study. These findings are consistent with a study in which 153 classrooms in 27 schools were assessed in order to identify the impact of the physical classroom features on the academic progress of the 3766 pupils who occupied each of those specific spaces. (Barret et sl, 2015). Within the classroom structure, seven key design parameters were identified and together explain 16% of the variation in pupils' academic progress achieved. These were light, temperature, air quality, ownership, flexibility, complexity and colour.

The Best Predictors of Performance from the Variables Investigated

Correlations of all the variables investigated were analyzed through regression. Step-wise regression identified variables that were positively related to student achievement. These variables were: area of the school, security of tenure, aesthetics and school pleasantness, security in the school, quality of school grounds, natural lighting through windows, quality of heat, paintwork to interior walls, graffiti occurrence, and condition of classroom furniture

Table 1.21:- Variables Positively Related to Student Academic Achievement.

	Year					Variable						
Boys	2011		Q3				Q20					
	2010						Q20					
	2009										Q34	
Girls	2011	Q2					Q20					
	2010	Q2					Q20					
	2009	Q2					Q20		Q24			
Mixed	2011		Q3		Q11	Q14	Q20					
	2010				Q11	Q14		Q22				Q39
	2009			Q10	Q11	Q14	Q20					Q39
All	2011	Q2	Q3	Q10	Q11	Q14				Q28	Q34	
	2010	Q2		Q10	Q11	Q14		Q22		Q28	Q34	
	2009	Q2		Q18	Q11	Q14				Q28	Q34	

Key:
Q2: Size of the school
Q3: Security of tenure
Q10: Aesthetics and pleasantness of the school
Q11: Security in schools
Q14: School grounds
Q20: Natural lighting through windows
Q22: Quality of heat
Q24: Paint work to interior walls
Q28: Graffiti occurrence
Q34: Condition of classroom furniture
Q39: Level of noise from the environment

The best predictor variables of student achievement were chosen through step-wise multiple regression. The column labeled R Square Change, gives the change in the value of R Square between the models. The last column, labeled Sig. F Change, tests whether there is a significant improvement in models as we introduce additional independent variables. It explains if the inclusion of these variables in different steps helps in explaining significant additional variance in the dependent variable.

Security of tenure, accounts for a 36.8% variance in performance among the boys and is significant within a 10% confidence level. When the next variable, the condition of classroom furniture, is introduced, a further 2.1% variance in performance can be explained (Table 1.22).

Table 1.22:- Variables Predicting Performance among Boys' Schools.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.606[a]	0.368	0.277	12.671	0.368	4.068	1	7	0.084
2	.624[b]	0.389	0.185	13.454	0.021	0.209	1	6	0.663
a. Predictors: (Constant), q3									
b. Predictors: (Constant), q3, q34									

In the girls' schools three variables were found to predict student achievement. The size of the school, accounts for a 49% variance in performance. When the variable natural lighting is introduced, a further 17.3% variance is noted. The third variable that is significant is paintwork to interior walls, accounting for a 25.2% variance (Table 1.23).

Table 1.23:- Variables Predicting Performance among Girls' Schools.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the	Change Statistics				
					R Square	F Change	df1	df2	Sig. F

				Estimate	Change				Change
1	.700[a]	0.49	0.417	12.144	0.49	6.723	1	7	0.036
2	.814[b]	0.663	0.55	10.666	0.173	3.073	1	6	0.13
3	.956[c]	0.914	0.863	5.886	0.252	14.706	1	5	0.012
a. Predictors: (Constant), q2									
b. Predictors: (Constant), q2, q20									
c. Predictors: (Constant), q2, q20, q24									

There are five variables predicting variances in performance in the mixed schools. The first, aesthetics and pleasantness of the school, accounted for an 11.2% variance. Second, security in schools accounted for an additional 12.7% variance. The next variable, quality of school grounds, explains a further 10.9% variance in performance. The second last variable was natural lighting. This explained a 9.9% variance in performance in the mixed schools. The final variable was level of noise from the environment and accounted for 3.8% of the variance in performance (Table 1.24).

Table 1.24:- Variables Predicting Performance among Mixed Schools.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.334[a]	0.112	0.031	8.069	0.112	1.386	1	11	0.264
2	.489[b]	0.239	0.087	7.835	0.127	1.667	1	10	0.226
3	.590[c]	0.348	0.131	7.642	0.109	1.511	1	9	0.25
4	.669[d]	0.448	0.171	7.462	0.099	1.44	1	8	0.264
5	.697[e]	0.485	0.118	7.7	0.038	0.511	1	7	0.498
a. Predictors: (Constant), q10									
b. Predictors: (Constant), q10, q11									
c. Predictors: (Constant), q10, q11, q14									
d. Predictors: (Constant), q10, q11, q14, q20									
e. Predictors: (Constant), q10, q11, q14, q20, q39									

The best predictors among all schools were finally examined together. The size of the school explained the 37.2% variance in performance in the schools. Introduction of other variables accounted for between 0.2% and 6.2% of student achievement (Table 1.25).

Table 1.25:- Variables Predicting Performance among All Schools.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.610[a]	0.372	0.349	12.208	0.372	16.022	1	27	0
2	.621[b]	0.386	0.339	12.306	0.013	0.57	1	26	0.457
3	.632[c]	0.399	0.327	12.413	0.013	0.557	1	25	0.463
4	.632[d]	0.399	0.299	12.669	0	0	1	24	0.999
5	.679[e]	0.461	0.344	12.258	0.062	2.633	1	23	0.118
6	.693[f]	0.48	0.338	12.312	0.019	0.802	1	22	0.38
7	.694[g]	0.482	0.309	12.575	0.002	0.088	1	21	0.769
a. Predictors: (Constant), q2									
b. Predictors: (Constant), q2, q3									
c. Predictors: (Constant), q2, q3, q10									
d. Predictors: (Constant), q2, q3, q10, q11									
e. Predictors: (Constant), q2, q3, q10, q11, q14									
f. Predictors: (Constant), q2, q3, q10, q11, q14, q28									
g. Predictors: (Constant), q2, q3, q10, q11, q14, q28, q34									

Studies in other parts of the world reflect some of the findings in this study. Kolb (2005) found that scores on reading speed and accuracy were higher in illuminated instructional environments. The study in Nairobi City County confirmed this idea. Natural lighting was a determinant of student academic achievement.

Wyon (1991) showed that student performance at mental tasks is affected by changes in temperature. Fang et al. (1998) found that office workers are most comfortable in the lower end of temperature and humidity comfort zones. These findings support the idea that students will perform mental tasks best in rooms kept at moderate humidity levels of 40% to 70% and moderate temperatures in the range of 68°F to 74°F. In the research undertaken in secondary schools in Nairobi City County, the quality of heat was found to be a determinant of achievement.

Poor indoor air quality (IAQ) can lead to certain health problems among students, including irritation of the eyes, nose and throat, upper respiratory infections, nausea, skin rashes, dizziness, headaches, mental fatigue or sleepiness. In the study in Nairobi City County, IAQ was found not to affect student achievement. However, in other studies indoor air quality has been linked to student performance (Kennedy, 2001; Leach, 1997).

The study in Nairobi City County noted that building condition had a correlation to student achievement. Paintwork to interior walls as well as aesthetics and pleasantness of the school are aspects of school physical conditions. Graffiti occurrence was closely linked to school aesthetics. It was found that school performance in public schools in Nairobi City County can be improved by between 13.7% and 17.2% when the school physical environment is good. It has been found that when the socio-economic status (SES) is controlled, schools experience a difference in both student achievement and behaviour (Cash, 1993; Earthman, et al., 1996; Hines, 1996; Lanham, 1999).

Burkett (1982) found that students learning in newer buildings outperformed those in older ones and posted better records for health, attendance and discipline. Similar improvements in newer facilities have been confirmed by Phillips (1997). Jago and Tanner (1999) also found such relationships to be true.

Conclusions:-

Based on the findings of this study, it was concluded that the physical environment influences student achievement. Specifically, it was established that the variables that explained student achievement in the environment included:, aesthetics and pleasantness of the school, sense of security, quality of paintwork to interior walls, occurrence of graffiti, condition of classroom furniture and the level of noise decibels from the neighboring environment.

Recommendations:-

This study recommends development of a maintenance programme of the schools' physical environment. A logical starting point would be to document all the degraded aspects of school physical environment and using a tracking tool cost the required repairs. Based on availability of financial resources, medium and long term maintenance programs can be drawn and implemented to restore and ultimately make physical environment of the schools positively influence student performance in competence based curriculum.

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