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RESEARCH ARTICLE

MAINSTREAMING THE SCHOOL PHYSICAL ENVIRONMENT IN LEARNING INSTITUTIONS: THE CASE OF SECONDARY SCHOOLS IN NAIROBI COUNTY, KENYA

[1,*]Dr. Paul Aloyo, [2]Dr. Solomon Mwaniki, [3]Prof. Caleb Mireri, [4]Dr. Peter Kamau and [5]Dr. Dennis Karanja

[1]Lecturer, Jomo Kenyatta University of Agriculture and Technology
[2]Lecturer, Mount Kenya University
[3]Professor, Kenyatta University
[4]Senior Lecturer, Kenyatta University
[5]Lecturer, Jomo Kenyatta University of Agriculture and Technology

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ABSTRACT

Globally, stakeholders in learning institutions have strived to improve the schools' physical environments in attempt to enhance learning outcomes of learners. The gist of this study was to establish whether the current status of the physical environment in the public secondary schools in Nairobi County have been mainstreamed to positively influence on the learning outcomes. The objectives of the study were: establish the extent of sufficiency of school land sizes; determine the status of schools land security of tenure; establish the status of maintenance of school buildings and; ascertain the adequacy of facilities for learning. The study adopted the case study research design. Public secondary schools were stratified into boys, girls and mixed categories. A further stratification along eight geopolitical divisions resulted into a sample of 39 schools. Results from a revised Commonwealth Association of Physical Environment (CAPE) questionnaire administered revealed that the overall average quality of mixed schools' index of 126 was lower than that of boys' and girls' schools. The indices for boys' and girls' schools were both equal to 134. A framework of improving school facilities from the foregoing results was, therefore, suggested with key features of upgrading old facilities, improve school grounds and controlling physical development around educational facilities

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INTRODUCTION

In 2000, most countries around the world pledged to achieve, by 2015, the six Education for All (EFA) goals (UNESCO, 2011). The United Nations Educational, Social and Cultural Organization (UNESCO, 2013) believes that the third goal of its global vision will ensure that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programs. Ruszala (2008) and Vandiver (2011) reveal that the physical environment of schools remains a focus of study in Europe and America because of the impact that environment has on the learners' learning outcomes. However, much remains to be done, especially in Third World countries like Kenya. According to the Dakar Framework for Action (UNESCO, 2000), 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. Learning environments must be safe and intellectually stimulating and that they must have pedagogy based on a learner-centered approach and democratic values and practices in the teaching-learning interaction. In light of this ambition, the paper explores the quality of the physical environment in public secondary schools in Nairobi City County, Kenya.

Literature Review

The provision of education facilities in Kenya is conceptualized along the population in a given area. The location requirements are that secondary schools be along pedestrian networks, within 500 and 600 metres of walking distance from residential areas. A consistent definition of neighbourhood size is important if consequent school learning infrastructure is to be provided. The handbook's vacillation between population sizes of 3,500, 5,000 and 8,000 to constitute a neighbourhood gives rise to misunderstandings on the provision of adequate learning spaces in secondary schools. The reality on the ground is different. How can the demand for

more land for school facilities for the increasing population in urban centres be met despite the boundaries of these urban centres being finite? A cursory look at land allocation in urban areas indicates that the smallest allocation to education is 2.0% in Thika town and the highest is 20.3% in Kitale town. These percentages have been shrinking due to annexation for non-educational uses (Ikawa, 2014). The average land use allocation to education in these urban centres is 9.4%. It gets worse in Nairobi City County; only 0.56% of its geographical land is allocated for education facilities. The secondary school concept consists of several facilities including an administration centre, classrooms, halls, libraries, laboratories, workshops, canteens, car parks, staff quarters and sanitation facilities. There should be 40 students per class from form one to four and co-educational facilities with an equal number of boys and girls whose ages range from 14 to 17 years. A circulation space per pupil of 6 m^2 and playfields should also be provided. The required area for a single stream is 3.4 hectares.

The spatial requirements for a double and triple stream are 3.5 and 4.5 hectares respectively. Where agriculture is taught, an additional 10% of the above minimum area should be added. Sharing of sports facilities is encouraged as long as there is no adverse negative effect as a result of the accruing benefits. In cases where teachers and other staff are accommodated within school grounds, an additional 2.5 acres should be provided. For boarding schools, 1 acre for every 200 pupils should be added. To forestall the problem of land shortage, a single stream should be allocated 6.9 hectares, in anticipation of school expansion. The maximum limit of 480 students in a school is to limit overcrowding. The increase in school size cannot be without limit. Parents often feel that large schools are less personal, fearing that children will be lost in the system. Putting academic issues aside, larger schools are more likely to have a good range of sporting, musical and other activities to draw on than smaller schools (Bishton, 2011).

Measuring the School Environment: The Commonwealth Assessment Physical Environment (CAPE) questionnaire instrument was designed after a review of literature on facility assessment instruments (Cash, 1993). A modified CAPE instrument was developed as it is appropriate for the situation in a Commonwealth country like Kenya. The variables studied under the external environment included age, area and size of the school, land tenure, master planning, consultants, maintenance, missing facilities, entrances, wayfinding, pleasant aesthetics, security, social spaces, green environments, school ground conditions, exterior wall painting, disaster preparedness, earth tremors and earthquakes, relief and topography and wind interferences.

Purpose and Objectives of the Study: The purpose of this study was to establish the extent to which efforts towards improving schools' physical environment for enhanced educational outcomes. The specific objectives of the study were;

- Establish the extent of sufficiency of school land sizes;
- Determine the status of schools' land security of tenure
- Determine the status of maintenance of school buildings and;
- Ascertain the adequacy of facilities for learning

Research Methodology and Design: A case study research design was adopted by the study. Primary data was collected from questionnaires administered, resource persons interviewed, and the observation of the physical environment. Secondary information consisted of published information in research journals, books, dissertation and reports which related the data to the school physical environment and student attainment in secondary schools. The target population was 72. The number of boys', girls' and mixed schools are 18, 22 and 32 respectively. The first step in the sampling frame was stratifying the public secondary schools along gender lines resulting in the boys', girls' and mixed school categories. The second step was to further stratify the schools in the geopolitical divisions that constitute Nairobi City County. The third step was to proportionally allocate the sample size, calculated as 39, among the schools chosen. The distribution of the schools was as follows; 9 boys, 12 girls and 18 mixed schools To sample a population of 200 individuals, a far smaller sample than that calculated using the normal approximation to the binomial is required. To determine the sample size for small populations, the normal approximation to the hypergeometric distribution was used as shown below.

$n = (Nz\text{^}2\ pq) / (E\text{^}2\ (N-1) + z\text{^}2\ pq)$

Where:

n = Minimum sample size
N = Population size
z = Confidence level at 90% (z value = 1.645)
p = Proportion of events in population (5%)
q = Proportion of non-events in population (95%)
E = Accuracy of sample proportions (4%)
The number of schools sampled from this model was calculated using this formula. The number selected was approximated upwards to 39 schools.
n = (72x1.645x1.645x0.05x0.95) / (0.04x0.04x71 + 1.645x1.645x0.05x0.95) = 38.2

Research Findings and Discussion

The extent of sufficiency of school land

Size of School Land: One of the most permanent paramount asset any institution has in the land on which physical infrastructures are put-on. This study sought to find out the sizes of school land in the study location. Most of the schools (66.7%) surveyed had an area of less than 4.5 hectares, while only 12.1% were built on over 13.5 hectares of land. The acreage in boys' schools was larger than that in girls' and mixed schools. Over 33.3% of boys' schools were built on more than 13.5 hectares, compared to the 14.3% and 11.1% mixed and girls' schools respectively (Table 1.0). Two approaches as to the meaning of school size are commonly adopted. Size may simply refer to the total number of students attending a school. It may, in addition, refer to the geospatial location of a school at a given date. The second approach is largely found amongst small school advocates. It views school size as a combination of the number of students, the physical size of school buildings, a particular set of values with decision-making practices, and a particular culture (Muir, 2000; Tasker, 2003). Muir (2000) supports the development of small schools whereas Tasker (2003) prefers smaller structures in secondary schools.

Table 1.0 Size of School Land

Category	Boys	Girls	Mixed	Total
Less than 4.5 ha	3(33.3%)	5(55.6%)	4(28.6%)	22(66.7%)
Between 4.5 to 9 ha	1(11.1%)	2(22.2%)	5(35.7%)	3(9.1%)
Between 9 to 13.5 ha	1(11.1%)	0 (0%)	3(21.4%)	1(3.0%)
Over 13.5 ha	3(33.3%)	1(11.1%)	2(14.3%)	4(12.1%)

Table 1.1: Influence of topography on school development

Category	Boys	Girls	Mixed	Total
Yes	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Yes, especially the development of the buildings	0 (0%)	0 (0%)	0 (0%)	2(6.1%)
Yes, especially the development of the buildings	1(11.1%)	1(11.1%)	1(7.1%)	1(3.0%)
No	8(88.9%)	8(88.9%)	13(92.9%)	29(87.9%)

Table 1.2: The condition of the school grounds

Category	Boys	Girls	Mixed	Total
No landscaping, and sidewalks are damaged	1 (11.1%)	0 (0%)	1 (7.1%)	2 (6.2%)
Parts of the school are landscape, others are not	3 (33.3%)	2 (22.2%)	3 (21.4%)	8 (25.0%)
Most school is landscaped, maintenance poor	0 (0%)	1 (11.1%)	3 (21.4%)	4 (12.5%)
The landscape attractive and well maintained	5 (55.6%)	6 (66.7%)	7 (50.0%)	18(56.2%)

Table 1.3: Social spaces in the external environment

Category	Boys	Girls	Mixed	Total
No	0 (0%)	1(11.1%)	2(14.3%)	3(9.1%)
No, but the administration is creating some	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Yes, but these are inadequate	0 (0%)	2(22.2%)	5(35.7%)	7(21.2%)
Yes	9(100%)	6(66.7%)	7(50.0%)	22(66.7%)

Table 1.4: Trees and other green environments adjacent to the buildings

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No, the school plans to plant	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Yes, but they are inadequate	0 (0%)	2(22.2%)	5(35.7%)	7(21.2%)
Yes	9(100%)	7(77.8%)	9(64.3%)	25(75.8%)

Table 1.5: Security of tenure

Category	Boys	Girls	Mixed	Total
No	1(11.1%)	1(11.1%)	1(7.1%)	3(9.1%)
No, yet to start processing title	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No, but processing one	1(11.1%)	1(11.1%)	2(14.3%)	4(12.1)
Yes	7(77.8%)	6(66.7%)	10(71.4%)	23(69.7%)

Table 1.6: Master plan for school development

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	1(7.1%)	1(3.0%)
No, but developing one	0 (0%)	1(11.1%)	0 (0%)	1(3.0%)
Yes, but it is outdated	1(11.1%)	2(22.2%)	0 (0%)	3(9.1%)
Yes	8(88.9%)	5(55.6%)	13(92.9%)	26(78.8%)

Table 1.7 Consultant involvement in planning infrastructure development

Category		Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Sometimes	1(11.1%)	1(11.1%)	2(14.3%)	4(12.1%)	
Most times	0 (0%)	7(77.8%)	3(21.4%)	4(12.1%)	
Yes	8(88.9%)	0 (0%)	9(64.3%)	24(72.7%)	

Table 1.8 Average age of school buildings

Category	Boys	Girls	Mixed	Total
30-39 years old	4(57.1%)	5(71.4%)	4 (28.6%)	13(46.4%)
20-29 years old	2(28.6%)	2(28.6%)	5 (35.7%)	9 (32.1%)
10-19 years old	1(14.3%)	0 (0%)	3 (21.4%)	4 (14.3%)
Under 10 years old	0 (0%)	0 (0%)	2 (14.3%)	2 (7.1%)

Table 1.9: Plan that prioritizes maintenance of buildings

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No, but maintain as problems arise	0 (0%)	0 (0%)	3(21.4%)	3(9.1%)
No, but maintain yearly	0 (0%)	2(22.2%)	2(14.3%)	4(12.1%)
Yes	9(100.0%)	6(66.7%)	9(64.3%)	24(72.7%)

Table 1.10: Duration exterior walls or windows were last painted

Category	Boys	Girls	Mixed	Total
Over 30 years ago	0 (0%)	0(0%)	0(0%)	0(0%)
Between 20 and 30 years ago	0 (0%)	0 (0%)	0 (0%)	0(0%)
Between 10 and 20 years ago	0(0%)	0(0%)	0(0%)	0(0%)
Less than 10 years ago	9 (100%)	9(100%)	14(100%)	32(100%)

Table 1.11: School activities hindered by the winds

Category	Boys	Girls	Mixed	Total
Yes	0 (0%)	0 (.0%)	1(7.1%)	1(3.0%)
Yes, even roofs of buildings have been carried	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Yes, shattered windows and inappropriate smells	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No	9(100%)	9(100%)	13(92.9%)	31(93.9%)

Table 1.12: Visual pleasantness of the school

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	1(7.1%)	1(3.0%)
No, but improvements are underway	1(11.1%)	0 (0%)	0 (0%)	1(3.0%)
Yes, especially the external environment	0 (0%)	0 (0%)	2(14.3%)	2(6.1%)
Yes	8(88.9%)	9(100%)	11(78.6%)	28(84.8%)

Table 1.13: Adequacy of facilities

Category	Boys	Girls	Mixed	Total
No	2(22.2%)	3(33.3%)	1(7.1%)	6(18.2%)
Yes, but in the process of planning & designing them	3(33.3%)	3(33.3%)	10(71.4%)	16(48.5%)
Yes, but in the process of building	3(33.3%)	2(22.2%)	3(21.4%)	8(24.2%)
Yes, nothing being done about it	1(11.1%)	0 (0%)	0 (0%)	1(3.0%)

Table 1.14: Accessing exits and entrances

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Some are hidden	0 (0%)	1(11.1%)	0 (0%)	1(3.0%)
Most are Visible	1(11.1%)	0 (0%)	4(28.6%)	5(15.2%)
Yes, all are accessible	8(88.9%)	8(88.9%)	10(71.4%)	26(78.8%)

Table 1.15 Spatial orientation of school facilities

Category	Boys	Girls	Mixed	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No, but improvements are underway	1(11.1%)	2(22.2%)	6(42.9%)	9(27.3%)
Yes, but students don't use the new routes	0 (0%)	0 (0%)	2(14.3%)	2(6.1%)
Yes	8(88.9%)	7(77.8%)	6(42.9%)	21(63.6%)

Both approaches are evident in the provisions for planning school facilities in Nairobi City County. The first approach is based on land acreage and requires secondary schools to have more land than primary schools. Extra land is needed for Chemistry, Physics and Biology laboratories, workshops, assembly halls and playgrounds. Provisions for the future should also be accounted for. They may be met, where there are land constraints, through the construction of high rise school facilities such as classes, offices and dormitories. The minimum area required for single, double and triple stream mixed secondary schools of forms one to four is 3.4, 3.5 and 4.5 hectares respectively. In schools where Agriculture is taught, additional land, estimated at 10% of the above minimum space requirements, should be added. According to the provided guidelines, a paltry 9.1% of secondary schools meet the planning requirements of at least 6.9 hectares.

One reason for non-adherence to school land size requirements is the policy of creating secondary schools from primary schools. Thus, the size of land in primary schools is diminished and the land requirements for secondary schools are not met. A second observation is the diminishing public school land due to the annexing the land by private developers, which was explained by the political economic theory (Ikawa, 2014). Ikawa expounded on how politics intertwines with economic structures in Nairobi City County in the process of capital accumulation. One way is the accumulation of capital through the annexing of public school land. This was particularly rampant in the 1990's in Kenya (ibid). Omole and Owoeye (2012) similarly document illegal encroachment onto secondary school land by speculators. School land ranging from 1.05 acres to 72.95 acres has been lost in Nigeria.

The second approach, that hinges school size on population of the students, is more popular among education practitioners. Bloom, Thompson and Unterman's (2010) findings reveal sustained positive effects of school size on student achievement. Similarly, Schwarte, Strefel and Wiswall (2011), using an instrumental variable approach to provide a rigorous evaluation of school size reforms in New York City, found that newly established small high schools have strong positive effects on student performance. In Nairobi City County, for a boarding school, 1 acre of land should be provided for every 200 pupils to cater for dining halls and dormitories. The minimum acreage proposed assumes an average of 40 students per class. Since all schools expand, even if a school starts off as single stream, it should be allocated at least 6.9 hectares in anticipation of expansion. The maximum size of a school is limited to 480 pupils to avoid the risk of congestion. Each school should therefore be developed to a triple stream capacity.

Since school size in acreage is closely linked to school size in population, the study found that 81.8% of the respondents surveyed did not feel that their schools were crowded. In 3% of the schools, the respondents felt that the number of students was too high. Crowding was evident in some facilities in 77.8% and 78.6% of girls' and mixed schools respectively (see Table 17). Since schools were barely meeting size requirements and student enrolment was on the rise beyond the triple stream recommended, a positive response for crowding was expected. This was not the case in the study. In Nairobi City County access to the public secondary school system overrides the concept of overcrowding in the facilities. Students are not required to attend public schools based on the geographical location of their residence, thus allowing them the flexibility to move to different public schools in case they feel a school is overcrowded. It must be noted however that there is no consensus on how to define a small school and, by extension, the ideal school. Lee and Loeb (2000), for example define small schools as those with fewer than 400 students and large schools as those with more than 750 students. The Gates Foundation on the other hand recommends no more than 100 students per grade level, corresponding to 400 students for a typical school comprising of grades 9 to 12 (Vander Ark, 2002). A proposal from the United States Department of Education sets a limit of 300 students through its Small School Initiative (US Department of Education, 2006). Lee and Smith (1997) advocated that the ideal high school should enrol between 600 to 900 students.

For purposes of this study, three key take-aways are apparent from the foregoing discussion for policy makers deliberating over the efficacy of school size. The first is that school size matters, whether it is conceived in terms of land acreage or the number of students. Conditional on average achievement and time invariant characteristics of a student, math scores are impacted by the size of school a student attends (Egalite and Kisida, 2013). The second take-away is that school matters most in the older grades where the schools are typically larger and students are not confined to a classroom most of the day. The high school student fits in this category in Nairobi City County. A final take-away is that non-ordered and adhoc school reforms complicate the application of the planning land standards with regard to the appropriate size of schools in Nairobi City County.

Terrain of School Land: In regards to terrain of the school land, this study sought to out the extent to which school land terrain could have hindered the development of the schools' physical structure. The results show that physical factors like relief and topography did not hinder the development of schools surveyed as shown by 87.9% of the respondents. In 6.1% of the cases, a hindrance to the development of buildings was noted; whereas 3% recorded difficulties in developing the sports fields due to rugged terrain (Table 1.1). In one of the Secondary School severe flooding is experienced when it rains. The school is located in the eastern region of Nairobi City County, which is a relatively flat expanse next to a river that is blocked by the low income settlements adjacent to the school.

The school site should be sufficiently elevated to avoid drainage from surrounding areas and adequately pitched to shed its own surface water quickly. Areas that recorded difficulty in the development of school infrastructure were at the intersection of the elevated portion and where the plains start. Excessive cuts and fills become an unavoidable but difficult method of construction. Areas of excessive rock outcrops are undesirable because of the high cost of construction. Rock excavation for foundations and service lines are expensive in such areas. However, occasional rock outcroppings and uneven surfaces, in an otherwise excellent site, need not count too heavily against it. These minor shortcomings may often be easily corrected or even turned to advantageous use through imaginative site design, thereby contributing to student achievement

Condition of School Grounds: The state of the school grounds is critical in creating a holistic conducive environment for learning. In this study, the condition of school ground was found as summarized by figure 4.9; The satisfaction with school grounds was at an average 56.2%, in the estimation of the study, which is modest. Girls had the best school grounds, at a 66.7% of respondents surveyed (Table 1.3). Malone and Tranter (2003) recognized that school grounds are sites for learning and that the environmental opportunities therein should be optimized. While younger children have a variety of other play spaces, the importance of school grounds for teenagers is heightened by the fact that the 12 to 19-year age group is the least likely to use public green spaces such as parks (DTLR, 2002). Future creative designs of school grounds should include green roofs where students can study and play. Organic vegetated buildings that mimic the landform and blends with the natural landscape, while adopting high technology, should metaphorically symbolize this vision.

Spaces for Socialization: Of respondents surveyed, 66.7% indicated that there were social spaces in the external environment. In mixed schools 50% of the respondents were satisfied that the social spaces provided were adequate (Table 1.4). Secondary school grounds are the only outdoor environments for use by young people, where they can socialize without feeling that they are poaching territory or are being viewed as a nuisance by the rest of the population (Titman, 1999). However, there is an inadequate number of facilities for teenagers outside school (Nestlé Family Monitor, 2002). Needs in a mixed school in terms of social spaces, differ from those of boys' or girls' schools. Integrated spaces to meet the needs of students in mixed gender schools should be developed. Cervantes (1999) asserts that common areas of socialization are associated with student achievement.

Green Environments: Of the respondents surveyed, 75.8% were satisfied with the availability of green environments in the school. The group with the least number of trees adjacent to schools was that of mixed schools (64.3%), followed by girls' schools (77.8%). Boys' schools had the best green environments (Table 1.5). The climate in Nairobi City County as well as its geology and soils is conducive for the growth of plants. These environments can be further improved through a systematic landscape design program that adds value to the learning process. The importance of green environments within a school setting cannot be denied. Green environments impact student self-esteem and attitude. Yarborough (2001) opines that green environments create opportunities for learning which in turn influence student achievement.

The status of schools' land security of tenure

Security of Tenure

Most of the schools surveyed (69.7%) had title deeds. Only 9.1% of the schools investigated did not have a title deed. However, there was indication that the process of acquiring a title deed was ongoing for schools that did not have one (Table 1.6). Land tenure constitutes a web of interests on land. First is intersecting interests where there is shared claim to land. Second is overriding interests where a sovereign power has authority to allocate or reallocate land through expropriation. Third is overlapping interests when several parties are allocated different rights to the same parcel of land. Finally, complementing interest when different parties share the same interest in one parcel of land and competing interests when different parties contest the same interests in the same parcel of land. The case in public secondary schools in Nairobi City County oscillates between the overlapping and complementing interests. The Education Act 2013 tries to provide for competing interests on land by including religious, local government and national government interests in the provision of school infrastructure. The insecurity of the land tenure has led to the loss of school land to developers, to the extent that all schools were required to have title deeds by the end of 2015. The mismatch between the stated acreage on the survey map and the actual size should be eliminated through the use of the geographic information systems (GIS). Security of tenure directly correlates to the development of school facilities hence influences student achievement.

Development of School Master Plan: The study noted that 78.8% of the schools polled had a master plan for development. However, of the girls' schools, only 55.6% were found to have one. This is low compared to the 92.9% of mixed schools and 88.9% of boys' schools that had developed a plan (Table 1.). The purpose of a facility master plan is to provide a valuable, fact-based planning tool for future facility-related decision making that is consistent with and supportive of the academic mission. It sets a logical course for capital improvements and facility management initiatives over a period of many years. Such a plan is a living document that supersedes the previous existing plan frameworks and should be re-examined and updated on a two-year review cycle. The improvements and development of school infrastructure occasioned by a good school master plan leads to better student attainment.

Professional Involvement in Preparation of School Master Plans: Results showed that on average, 72.7% of the schools considered had the help of consultants in planning the facilities. Professionals were engaged in planning school facilities in 88.9% and 64.3% of the boys' and girls' schools respectively (Table 1.8). The Nairobi City County government has a building and facility approval process and it is therefore expected that the development of or alterations to the school built environment is appreciated and upheld by professionals. No school, it is presumed, should undertake any construction without approval from the relevant departments of Nairobi City County. An account for this anomaly may be attributed to the fact that public schools, being government controlled, need not apply the development guidelines to the design and management of school facilities. Such laxity in the design and supervision of school facilities results in poor quality of school infrastructure. Lessons from Singapore's Ministry of Education, where a project development and management department manages school infrastructure, are insightful to solve this problem. In addition to managing facilities in schools, the department has a research and procurement section that aids in the sourcing of new technologies for construction as well as bulk procurement of items for schools (Ministry of Education Singapore, 2014). Built environment professionals focused on the development of school facilities within the education department should be engaged by the Nairobi City County. Building Education Success Together (BEST), a collaboration of experienced school facility and community based groups, recommend that school development should not be left to the so-called expert consultants alone. Public participation must be increased in facility planning and thus enable schools to be centres of community (BEST, 2005). Such an approach is now a key component requirement in the Constitution of Kenya (Republic of Kenya, 2010), thus reducing the expert know-it-all approach. An inclusive and broad based approach to planning new and existing facilities will of course require the inclusion of other professionals like environmentalists and sociologists who hitherto have been marginally involved in school facility planning.

The Status of Maintenance of School Buildings

Age of School Buildings: The study found that on average, 46.4% of public secondary school facilities in Nairobi City County are between 30 and 39 years old. The average age of school facilities in girls' schools within this age constituted 71.4% of the building stock, compared to those of the boys' schools at 57.1% and 28.6% in mixed schools. Of the school building stock, only 7.1% has been constructed over the last 10 years (Table 1.9). In a study by Bullock (2007), students were found to perform better in schools with buildings aged less

than 19 years compared to schools which had buildings over 40 years. Lewis (2001) noted that reading scores are the single most accurate indicators of the ability to do academic work and are influenced positively by newer buildings. Other studies concur that students in newer buildings perform at a higher level than those in older buildings (Cash, 1993; Hines, Earthman and Lemasters, 1996; Stevenson, 2001; O'Neill, 2001). Older buildings usually do not have the main attributes of a modern building that are associated with a positive physical environment conducive for learning like the provision that allows a wide use of technology. An obvious implication is the need to modernize the school building stock for public secondary schools in Nairobi City County where the age of buildings in many schools is approaching the 40-year mark.

Maintenance of School Buildings: From the respondents surveyed, 72.7% indicated that a plan that prioritizes maintenance of buildings was in place. Girls' and mixed schools recorded a lower preparation in maintenance works as shown by 66.7% and 64.3% of the responses respectively. A 100% response rate indicated the readiness of boys' schools to deal with maintenance problems that arose (Table 1.10). The Draft National Building Maintenance Policy of 2011 anchors its provisions for maintenance in the Constitution of Kenya (Republic of Kenya, 2010) which emphasizes the need for a clean environment and adequate housing as a right of every citizen. The policy statement requires the establishment of an elaborate inventory of the building stock. A system of undertaking planned and periodic surveys of buildings is also made mandatory. These provisions are meant to deal with the sick building syndrome, which is defined as unhealthy and unsafe, dilapidated and decayed building environments. Such environments degrade the quality of life and contribute to poor health, low productivity and antisocial behaviour. Within the school context, the sick building syndrome negatively affects student performance. Eshiwani (1993) argued that the cheapest and most available materials should be used in constructing school facilities. This outlook must be contextualized, as the foremost requirement then was to offer many school facilities and therefore less emphasis was made on the provision of quality school building stock. Challenges related to facility management and life cycles were immaterial, their impact on student learning notwithstanding. Colgan (2003) reflected this view when he noted that whenever there is a heightened need for school buildings, especially due to a rapidly expanding population, the resulting constructions are often inexpensive and inadequate. Glass (1990) suggested five phases that constitute the school infrastructure life cycle. In the first 20 years of a building's life, the maintenance costs are normally limited to minor repairs and small improvements to reflect changes in the instructional programme. In the next period, between 20 and 30 years, the facilities require increasing amounts of annual maintenance and frequent replacement of worn out equipment. From 30 to 40 years, the need for general maintenance increases rapidly. Most of the original equipment should be replaced, and major items such as roofs and lighting fixtures also need replacement during this period. The time of accelerated deterioration is between 40 and 50 years. In most instances, the neighbouring communities to schools have changed and the school may no longer be located in an area where there are children. Buildings in this phase may be too new to abandon if they were well constructed, but too old to provide an effective learning environment. Beyond 50 years, the buildings should either be completely reconstructed or abandoned.

The age of buildings, is inevitably associated with deterioration of school facilities (Honeyman and Sayles, 1995). The 10-year phases afford a user friendly timeline on which a maintenance programme in girls' and boys' schools in Nairobi City County should be developed. Even with maintenance programmes in place, education today is delivered in an entirely new manner, with new tools, techniques and teaching methods that do not fit into the old patterns of school design (Lyons, 2001). Ott (1976) noted that school administration should be sensitive to the needs of teachers during renovations and suggested the involvement of stakeholders in the planning process of renovation to reduce stress levels among students and teachers and improving their self-esteem in the process.

The Portuguese government launched a policy to rehabilitate 332 secondary schools in 2007, with a total investment of 2.45 billion Euros for the first 205 schools. There were three principal concerns in relation to the school building stock. First was physical deterioration. Second was poor environmental standards in terms of energy performance, environmental comfort and sanitary standards. Finally, the buildings were functionally inadequate for teaching (Blyth et al., 2007). The lesson is that there reaches a point when the need for massive capital improvements and renovations in school infrastructure are necessary become inevitable.

Painting of Exterior Walls and Window Frames: Painting is considered a cost effective means of improving the visual aesthetics of school infrastructure. The table below shows the status of paintwork to external walls and window frames. It is apparent from the figure 4.10 that; in Nairobi City County, 100% and 96.8% of the respondents probed noted that the school external walls had received a coat of paint in the last 10 years. The window frames had also been painted over this duration in 96.8% of the school surveyed (Table 1.11). Ruszala (2008) and Yarborough (2001) pointed out that building practitioners should consider the colour of paint on new or existing buildings as it contributes to teacher satisfaction in high schools thereby positively impacting on student achievement. However, it should be noted that many materials release volatile organic compounds (VOCs), paint being one of the worst offenders. Paint often contains harmful chemicals, including heavy metals. Fumes from VOCs and other substances in paint irritate the eyes, nose, throat or skin. They also cause headaches, dizziness or nausea. Some substances in paint cause kidney or liver damage. Paint used to be even more dangerous when it contained lead, which causes numerous health problems, including memory loss, learning difficulties and cancer. Lead was banned as an ingredient in paint in 1978. However, schools built before then have old layers of lead paint. When walls or ceilings are scraped to prepare for a new coat of paint, this older lead paint is exposed. When painters are not careful, lead dust or paint chips escape into the air.

Impact of Wind Interference on School Infrastructure: As for the constraining possible effects of wind, 93.3% of the respondents surveyed recorded that this was not a problem in the development of school infrastructure. Problems associated with wind were experienced in 7.1% of the mixed schools (Table 1.12). Wind creates inward and outward acting pressure on building surfaces, depending on the orientation of the surface. Such orientation may be flat, vertical or low sloping in nature. As the wind moves over and around the building, the outward-acting pressure increases as the building geometry forces the wind to change direction.

As pressure increases, uplift is created on parts of the building, forcing the building parts to fail if they are too weak to resist the wind loads. When wind forces its way inside or creates an opening by breaking a window or penetrating the roof or walls, the pressures on the building increase even more. Heavy building materials, for example reinforced masonry or concrete, that are well tied to all other building components often survive extreme winds. The weight of these materials helps resist uplift and lateral loads. They also tend to stop windborne debris that can increase damage to the building. However, heavy concrete roof panels and heavy masonry walls that are not adequately connected or reinforced, fail during severe winds. The study found that schools in Nairobi City County used stone as a main construction material; hence neither wind speed, nor wind direction adversely affected the building stock.

Building shapes that 'catch' the wind, such as overhangs, canopies, and eaves, tend to fail and become 'sails' in extreme winds. Flat roofs can be lifted off when the wind flows over them. The extreme winds pick up and carry debris from damaged buildings and objects located in their path. Even heavy, massive objects such as cars, tractor trailers, and buses are moved by extreme winds and cause collateral damage to buildings. Light objects become flying debris, or missiles, that penetrate doors, walls, and roofs. Heavier objects roll and cause crushing-type damage. Winds also carry minute particles and gases. Should the openings face the windward direction, irritants such as smoke and odours distract students thus lowering their performance. An example was found at Kamukunji Secondary School where the cannabis sativa fetor from the neighbouring Jua Kali sheds affected student concentration.

Adequacy of facilities for learning

Pleasantness of School Facilities: The respondents surveyed were consistent in their view that their school environments were pleasant to look at. At an average of 84.8%, school facilities were aesthetically attractive. Only 3%, a small percentage, said that their schools were displeasing (Table 1.13). Vernon and Greenberger's (1978) aesthetic theory on vandalism in schools proposed that variables accounting for the enjoyment associated with socially acceptable aesthetic experiences are similarly responsible for the pleasure associated with acts of destruction. Aesthetic variables that bring pleasure serve as discriminative stimuli for destructive behaviour. Ruinous behaviour among students' targets school facilities for destruction, leading to a decline in student achievement.

Adequacy of Facilities for Learning: Of the schools surveyed, 48.5% reported that not all facilities required for a public secondary school were available. In 11% of the boys' schools, respondents indicated that nothing was being done to alleviate the problem of missing school facilities (Table 1.14). The Physical Planning Handbook (Republic of Kenya, 2012) indicates that a secondary school should have the following accommodation requirements: an administration block, classrooms, a multi-purpose hall, a library, laboratories, a workshop, a canteen, a car park, staff quarters, sanitation facilities and playfields. They constitute the minimum spatial requirements for a public secondary school. However, the guidelines are silent on the provision of a health facility.

The findings of inadequate facilities are attributed to underfunding that has not increased proportionately with increasing student enrolments in public secondary schools. These findings are similar to a study of the Status of Missing Physical Facilities in Government Schools of Punjab (Muhammad Saeed and Khalil Ur Rehman Wain, 2011). The study was designed to investigate the missing physical facilities and actual needs of the public sector schools of Punjab Province in Pakistan. The survey revealed that the majority of schools had problems such as shortage of furniture, lack of Science, Maths, Computer and English teachers, inadequate information technology facilities, shortage of classrooms, inadequate light in the classrooms, and inadequate toilet facilities. A dire need for school improvement in terms of missing physical facilities to meet the learning needs of the students was proposed in Punjab. Stevenson (undated) was able to link missing facilities in schools to student achievement especially lack of storage and laboratory spaces.

Accessing School Facilities: Entrances and exits to the school were easily identified, as indicated by 78.8% of respondents surveyed. In 11.1% of the girls' schools, however, they were hidden and not easily identifiable (Table 1.15). From the road, the entrance of Jamhuri Secondary School is partly hidden from view due to the encroachment of various land uses on the road reserve next to the school. The Building Code provides the requirements of ingress and egress of all public school buildings thereby predetermining the safety and welfare of occupants. The number and sizes of such exits shall be calculated using a formula that takes into consideration the number of persons and population density of users. The formula is mathematically modeled as:

$$A = Z \times \textit{Floor area in sq. ft.}/E \times B \times C \times D$$

Where:

A = Number of units of exit width required
B = Construction of buildings
C = Arrangement and protection of stairs
D = Exposure hazards
E = A factor dependent upon height of floor above or below ground level

A lacuna exists in the guidelines as to the adequate number of access points to the neighbourhood from the school. Controlling access to and from the school is closely related to territoriality leading to the communal ownership of the school. It also acts as natural surveillance along the school fence. However, too many entry points may achieve the reverse, especially in a community where there are incidences of drug abuse and other vices. The design principles of access control on school grounds rely on physical barriers such as the strategic placement of gates. Limited access points allow school personnel to better monitor the comings and goings of individuals during school hours. For example, the main entry to a school can directly funnel people into administration offices, helping to monitor visitor access. The end result is a decrease in the disruption of the learning process.

Spatial Orientation in School Facilities: It was easier to find one's way around boys' schools than around mixed schools, as indicated by 88.9% and 92.9% of respondents, respectively. Girls had a 55.6% response rate on the ease of finding their way in schools (Table 1.16).

An explanation for the discrepancies noted above could be that in mixed schools, there exists a challenge concerning the activities that boys and girls can engage in together in terms of both time and space. Students found by school administrators at the wrong time in the wrong place probably accounts for the problem of way finding. Weisman (1981) posited that the geometric and configuration features of an environment influence human orientation and navigation. He identified four classes of environmental variables shaping way finding situations: visual access, degree of architectural differentiation, the use of signs and numbers and floor plan configuration. Best (1970) had earlier pioneered a study on indoor navigation where he identified fundamental aspects of a building's route network, like choice points, directional changes and distances as relevant predicators of spatial orientation in complex buildings. The observations in the study are at odds with findings that expect regular users of facilities to easily navigate them (Hölscher et al., 2005). In any case the sizes of schools were neither too large nor too complex for cognition by secondary school going students. The apparent contradiction can be resolved by vacating the idea that cognition of the school environment remains constant among the boys whether they are apart or together. Spatial orientation encourages a sense of ownership of the school environment and hence less incidences of vandalism.

Conclusions and Recommendation

The study concludes that the external environment of school infrastructure is on the decline. Reasons for this trend in the deterioration and subsequent decline of quality of the building stock in public secondary schools was attributed to the age of the school facilities, use of substandard building materials, inadequate funding and a non-targeted policy framework for school infrastructure development.

The study proposes two approaches in the funding of the development of school infrastructure. The first approach is to design policies funding with specific reference to children from poor regions of Nairobi City County so as to upgrade their facilities to standards that acceptably high, thereby leveling the playing field in so far as school infrastructure is concerned among secondary going students. A second alternative is to base public allocations to schools on need (Watkins and Alemayehu, 2012). The greater the need for school infrastructure development, the more the resources assigned.

A logical starting point is to document, using a tracking tool, the cost of all degraded aspects in the school physical environment that require repair. Developed within a medium and long term maintenance program, the physical facilities should be restored and ultimately replaced with new infrastructure in a systematic manner.

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