René John Dierkx

Inclusive learning environments for Nairobi's children and youth: Lessons for community-based affordable, sustainable, and child-centred school development

Peer reviewed

Abstract

As its point of departure, this article takes the view that if local communities in Nairobi are involved in the development of inclusive learning environments, from inception to implementation and maintenance (using appropriate tools and school models), then such schools will likely be more affordable, and sustainable, than current (non-sustainable and expensive) school construction practices in Kenya. In addition, community-based school development will enhance the notion of community ownership. There is evidence that lack of safety and health, environmental degradation and the poor sanitary and technical state of schools, affect children. However, funding of educational development in Africa mostly emphasizes reform of educational policies and programmes, training, and edu-cational materials provision. The importance of inclusive learning environments in supporting education in Africa is usually not recognised by local authorities. Inclusive school environments are likely to have a positive effect on motivation, academic performance and community ownership. Communities should be taken seriously in the development of schools, since, due to their public nature, schools can play a guiding role in sensitisation, creating awareness, understand-ing and action taking in Sustainable Development issues. The introduction of Curriculum 2005 in South Africa, together with new learning and teaching methods, new technologies, decentralisation of education and shift of responsi-bility towards the schools, may be a unique opportunity to implement the concept of inclusive school development in conjunction with the local communities, and draw on the environment and local resources for learning.

Keywords: Community participation, learning environments, environmental assessment, narratives, school construction, inclusive schools, sustainable tropical design, Kenya, choice of technology.

Dr René John Dierkx, Architect and urban/educational planner, Research fellow TU/e and consultant, Eindhoven University of Technology, Faculty of Architecture, Building and Planning, PO Box 513, 5600 MB Eindhoven, The Netherlands. Tel: +3140 2474050, Fax: +31 40 2475887; Email: <r.j.dierkx@bwk.tue.nl>.

INKLUSIEWE LEEROMGEWINGS VIR NAIROBI SE KINDERS EN JEUG: LESSE VIR GEMEENSKAP-GEBASEERDE, BEKOSTIGBARE EN KIND-GEORIËNTEERDE SKOOLONTWIKKELING IN SUID-AFRIKA

As 'n vertrekpunt vir dié artikel word die standpunt gehuldig dat indien plaaslike gemeenskappe in Nairobi vanaf die aanvang tot met die inwerkingstelling en tydens die onderhoud (met behulp van toepaslike gereedskap en skoolmodelle) betrokke kan wees by die ontwikkeling van inklusiewe leeromgewings, skole moont-lik meer bekostigbaar en volhoubaar sou kon wees as die huidige (nie-volhoubare en duur) skoolkonstruksiepraktyke in Kenia. Verder sal gemeenskap-gebaseerde skoolontwikkeling, die konsep van gemeenskaplike besit bevorder. Op die gebied van gesondheid en veiligheid word leerders sleg geraak deur aspekte soos omgewingsverval, swak sanitasie en die tegniese toestande van die skole. Dit is waar dat die befondsing van opvoedkundige ontwikkeling in Afrika merendeels fokus op die hervorming van skoolbeleid en -programme, opleiding, en op die voorsiening van opvoedkundige materiaal. Die belangrikheid van inklusiewe leer-programme in die bystand van skoolonderrig in Afrika word gewoonlik nie deur plaaslike owerhede erken nie. Inklusiewe skoolomgewings kan moontlik 'n positiewe invloed uitoefen op motivering, akademiese prestasie en gemeenskaplike besit. Gemeenskappe moet ernstig opgeneem word wanneer skole opgerig word. Weens die openbare aard daarvan kan dit 'n leidende rol speel om mense meer sensitief en bewus te maak én 'n begrip kweek vir aspekte rondom volhoubare ontwikkeling. Die bekendstelling van Kurrikulum 2005 in Suid-Afrika, nuwe leer- en onderrigmetodes en tegnologie, desentralisasie in die onderwys en 'n afwenteling van verantwoordelikhede na die skole self, kan 'n unieke geleentheid bied om die konsep van inklusiewe skoolontwikkeling te implementeer in samewerking met die plaaslike gemeenskappe. Sodoende kan die omgewing en die plaaslike hulpbronne ook beter benut word.

Sleutelwoorde: Gemeenskapsbetrokkenheid, leeromgewing, omgewingsraming, verhale, skoolkonstruksie, inklusiewe skole, volhoubare tropiese ontwerp, Kenia, keuse van tegnologie.

Introduction

In many African countries the 1990s was a period of economic, technological, and political regression. From 1990 to 1998 the number of people living in extreme poverty in Africa increased by 48 600 000 million people (UNCHS 2001). An average 46,3% of all people in Africa live on less than one US$ a day (World Bank 2000). Sub-Saharan Africa is the world's poorest and least developed region with a Human Development Index of 0,471 (UNDP 2002). Its rapidly urbanizing cities absorb the largest share of this poverty, which is closely linked to the spread of diseases, health risks, lack of secure shelter, hunger, lack of access to basic services, serious degradation of the environment, and a decline in public expenditure on education and health. Children living in major cities suffer most from these deficiencies.

International development efforts such as the Campaign on Education For All (EFA) promote education as the key to development, and improving access to schooling is seen as a major factor in the eradication of poverty. However, access to education varies in Africa, and is mostly based on sex, socio-economic status, ethnic background and 'good contacts'. In addition, the impact of 'cost-sharing' seems to have been anything but positive. It contributed largely to a decline in development and maintenance of schools as regular school construction is out of reach for local communities.

The schools in Africa have problems with safety, health, and poor environmental sanitary and technical conditions, due to years of neglect by local authorities. There is evidence that these problems affect both pupils and teachers. Hence, the UNESCO-Dakar World Education Forum stressed the creation of safe, healthy and environmentally inclusive schools (UNESCO 2000). This was also emphasized at the UNESCO Sub-Saharan Consultation on School Construction and Educational Facilities (UNESCO 2001). Educational investment in Africa mostly emphasizes reform of educational policies and programmes, teacher training, and educational materials provision to improve enrolment, access, learning performance and lower dropout. The need for school environments that are favourable and inclusive in supporting quality education is usually not recognised by the local authorities.

Inclusive school environments are likely to have a positive effect on motivation and academic performance, (UNESCO 1994, 1996, 2000, 2002). However, many of these reports basically aim at the learning environment as a non-physical environment to enhance learning and do not consider the learning environment as a whole, i.e. the physical, mental and spiritual school environment as interlinked. Local communities should thus take over where the authorities have left off. Hence, in

developing inclusive schools, communities should be involved from the start.

This article will focus on the development of inclusive learning environments for Nairobi and the lessons it holds for sustainable, community-based and child-centred school development in South Africa. We will discuss the condition of Nairobi school children, key issues in financing school construction. The need for inclusive schools, a field survey, a case and its implications, and the main conclusion that states that, con-trary to current practices and literature, affordable and sustainable school development is an appropriate option for the authorities and communities in Kenya.

Growing up in Nairobi

The conditions that children face in Nairobi make it difficult for them, firstly to get admitted to a school, and secondly to receive a safe, healthy, and environmentally inclusive education as well. The 1 064 000 children who will reach primary school age (6-14 years) in Nairobi from 2000 to 2010, all have the same barriers to cross (UNCHS 1996). There are many difficulties school-going children in Nairobi face, which also impede the provision and upkeep of schools.

Many private schools are established as business enterprises. Their main objective is merely to gain school fees, levies and 'development' funds. Many do not meet basic standards of safety and health, and while officials have to inspect the schools to ensure that they are conducive to learning and teaching; this is rarely done (*Daily Nation*, April 2000). The building industry, professionals and authorities are often hesitant to use new technologies apart from 'modern' building methods and materials. Sustainable, more affordable approaches have seldom been adopted. The architectural education and the outdated building code are also barriers to this, even when energy-efficient and cost-effective alternatives are available (Njuguna 1997).

Most city council schools are in a run-down condition, as maintenance has fallen behind. The government stopped financing (the expensive) education and introduced the concept of 'cost-sharing' to the community that was favoured by the World Bank and the International Monetary Fund. However, the impact of this seems to have been anything but positive (*Daily Nation*, March 2000). Education is very costly. Most parents cannot afford the fees, costs for uniforms, books, furniture, transport, lunches, and 'development-funds'. Public transport exposes school children to many dangers: the speeding of vehicles, the ignoring of zebra crossings, and other violations of the traffic laws, have increased the incidence of pupils killed in Nairobi in the recent past. Zebra cross-

ings, fly-overs and traffic lights are also largely absent (*Daily Nation*, July 2000). Many schools have problems with burst sewers and garbage dumps that pose health hazards to children, as waste from the surrounding slums floods school grounds during the rainy season. Factories and public transport create excessive noise, dust, and pollution that in turn create concentration and respiratory problems. Lack of maintenance of public spaces causes problems with dust when the school ground has no vegetation and green groundcover. There is serious degradation of the environment at many school locations.

Street gangs terrorise pupils and teachers and loot school properties. This causes stress, fear, and a general decline of educational standards. School children and street children alike have not been spared the consequences of crime and the moral decadence of slum (street) life. Incest, rape and child prostitution are all familiar phenomena to the pupils in slum areas, where all seems to revolve around cheap sex and illegal liquor (*East African Standard,* August 1999).

There is a lack of consultation with and involvement of communities as a result of a lack of respect and not taking the needs and aspirations of people seriously. Top-down approaches are applied (if financial resources are available) in providing spaces for education at the municipal level. Finally, innovative approaches to ensure more climate/cultural-fit and cost-effective school prototypes are lacking. Plans have not been adapted to improve the energy-efficiency, cost-effectiveness, aesthetics and functionality of learning spaces more suited to the needs, budgets and comfort of users.

Financing and distribution of schools

A crucial barrier to school development is financial constraint. The policy of 'cost sharing' gives parents a great financial burden. They have to pay for textbooks, uniforms, and shoes and contribute to other 'development funds'. In poor areas in Nairobi, this causes high dropout rates.In 2002, 240 city council primary schools were operational in Nairobi's 693 square kilometres, yet some areas have relatively few schools. By 2010, the estimate is that the number of children in Nairobi will have grown to 1 86 000 of which 1 064 000 will be of primary school age. Hence, in the coming decade the pressure to build schools will be great as the rate at which schools are built, 3, 15%/year (Dierkx 2002), cannot keep pace with the rate of urbanization. Enrolment in Kenya decreased from 95% in 1990, to 88,8% in 1998. The UN put enrolment at primary level at 76 percent in 1999 (Wachiri 2001; Mathiu 2002). For Nairobi this means that out of 1 064 000 children only 808 640 will find a place in a school, and that only when the schools have actually been built (UNCHS 1996).

In 2002, the Kenyan Government allocated, 57 percent of its educational budget to primary education, and of this over 94 percent goes to teachers' salaries. Thus little is left for school development, as the budget allocated to Primary Education is not adequate to construct sufficient schools to meet current and future demands. Expanding existing schools is not a relevant option, as many schools range from 500-1 700 pupils/school. The alternatives are community-based development or private sector development of schools as a business enterprise (Koech 1999).

Schools are supposed to be built in compliance with a building code that places restrictions on the choice of building materials. Conventional materials like concrete blocks and fired clay-bricks are permissible for construction, but innovative local building materials or recycled materials are disapproved. Interestingly enough, the latter materials are not only the most affordable, but also locally available and sustainable. A serious reconsideration of the Kenya building code, viz setting intermediate or minimum standards for school development, would be sensible, not only for schools, but also for other buildings as well, as the prices of code-compliant materials (labour inclusive) have increased considerably from 1990 to 2000.

Key issues in school construction costs in Kenya

To better prepare schools and to ensure that the development and delivery of schools meet the challenges of the future, in non-and post-conflict situations, we have to find quality educational space to support quality education. Hence, we have to develop schools that are affordable, sustainable, cost-effective and inclusive, with a learning environment that is both conducive to learning and teaching. To achieve this we first have to make the following analyses on which to base our decisions. We shall have to:

1) Analyse school costs to make the right choice of resource allocation)

2) Analyse learning space to encourage flexible use and small- and large-group work

3) Analyse learning programmes and create multiple openings for learning (integrate community and landscape)

4) Analyse storage facilities for equipment, materials, work in progress, etc

5) Analyse sources of information and increase their variety, i.e. conventional and new learning methods, CD-ROM, Internet, etc.

6) Analyse investment in new educational technologies (ICT)

7) Analyse modes of school delivery, (stakeholders and the community)

8) Analyse possibilities of community-based approaches to planning and design, (including children and youth)

9) Analyse levels of school violence

10) Analyse administrative and legal barriers to community school development (loans, licenses and standards)

11) Analyse the need for local school resource advisors assisting communities

12) Analyse modes of textbook purchase and use (school owns, student rents or pays a guarantee)

13) Analyse how sustainable and inclusive school development can form a basis for eco-city planning

14) Analyse school prototype plans (costs, flexibility, adaptability, sustainability); organise a design competition for architectural students for new, affordable, sustainable and inclusive school models

15) Analyse and modify planning and design practices, curricula and building research centres to aim at safe, healthy, environmentally inclusive development and design approaches for sustainable progress of the human and natural habitat.

School costs

> Creating sustainable and inclusive learning environments means that it is a good investment policy to aim at developing a healthy, content and productive human capital, and poor economic policy to allow people to become malnourished, unhealthy, and illiterate (Dierkx 2002).

The price and recurrent costs of a school and its users are generally determined by:

US$ Σ [Classroom (costs/pupil place) + environmental + landscaping + land or rental + Infrastructure + public services and security + furniture + materials and building + maintenance + learning materials and technology + personal (books, stationery, etc) + school transport + extra-curricular and development] COSTS.

Affordable learning space for all

Realising adequate educational facilities does not have to mean large new buildings or complex ways of organisation. Integrating community services (dispensary, kindergarten, resources centre, etc) together with

educational spaces, allows for their more intensive use, thereby creat-ing affordable spaces for all. Considering the limited resources that are usually allocated to education, governments should aim at long-term, cost-effective solutions:

- The investment cost has to be calculated accurately together with a simple but detailed cash-flow analysis showing how the total project cost can be spread over different building phases. Hence, annual education budgets can facilitate the construction of more schools
- The architectural design and the choice of building materials are crucial as they can increase lifespan and therefore help reduce costs
- Buildings should be constructed in the shortest time possible. Efficient construction management prevents costly delays or costs getting out of control
- Maintenance starts with the choice of materials that can be repaired by the community. A realistic budget line to ensure adequate maintenance should be included in the project budget
- Unfriendly, dilapidated schools are breeding-grounds for illiteracy and violence. If education contributes to a better quality of life then the physical learning environment should be sustainable, inclusive and attractive to the users. That is why local communi-ty participation (including children) is very important in defining local needs, choosing the school site, and determining the shape of the learning space.

Impediments to school development

There are many budget constraints and barriers hampering school construction in Kenya that have to be dealt with by educational specialists, architects, administration, and the local communities (*Table 1*). Cost control of school development has become a very important issue over the years; with the increasing numbers of children of school-going age in urban areas, thus the need for more schools, together with the escalating prices of materials, have made this an important issue.

Table 1 : Impediments to school development in Nairobi

Educationist	Administration	Architect	Communities
Type of curriculum	Building standards/specific.	Space arrangement	Level of self-help
Enrolment data	Budget providing authority	Climate: human confort	Fund-raising: community
Teacher/pupil ratio	Funds by donors/NGOs	Form of construction	Quality labour & materials
Pupil number/school	Cost of furniture	Environmental costs	Acquisition/securing land
Type/Use of the school	Site costs	Maintenance and repair	Level of organisation
	Contracting procedures	Price labour & materials	
	Transport: labour/materials	Technical detailing used	
		Level of supervision	
		Passive/active solar meth.	
		Use of life-cycle analysis	

Source: Koech 1999; UNESCO 1971, 1997; Dierkx 2002

Note on space per pupil

Normally, costs of school buildings are largely influenced by the amount of space. Thus, to keep costs to a minimum, taking into account the educational functions in the school, there should be adequate space control (minimum circulation space, creating many opportunities for learning) including corridors, toilets and verandas. Around 70 percent of the total school floor area can be set aside for teaching, if the layout and circulation are carefully planned. Outdoor learning will increase the space for project-based learning, for example, environmental educa-tion incorporated in all subjects. Thus, to keep building costs low it is important: 1) to control space (focus on creating learning environment), and 2) to set minimum standards for construction and finish. If both are achieved, then it will be possible and easier, eventually, to move to setting a maximum cost per pupil place or per unit of accommodation.

Hence, what should we invest in? 1) Aim at integrating urban planning, architecture, education, and sustainable and community development, since schools, due to their public nature, can play a pioneering and guiding role in sensitisation, awareness creation, understanding, and action-taking of issues dealing with sustainable development such as inclusive learning environments, environmental and waste manage-ment, sanitation, security, health, income-generating activities, etc. 2) One of the promising options is community-based assessment, development, and realisation of inclusive sustainable learning environ-ments that allows local communities (inclusive of children, youth, and women) to participate and be in control over their school project from the inception phase all through to the realisation and maintenance

phase, with the support and advice of local school resources advisors. Hence, the real needs and budgets of communities are better met against a more affordable price.

Alternative options for school development: the case of Nairobi

It is estimated that the cost of a new and basic classroom in Kenya (Nairobi) ranges between 12 000 to 20 000 Ksh (contractor-built). UN estimates are, that from 2000 to 2010, the number of children of primary school-going age (6-14 years) will increase from 7 31 500 to 1 06 million children (Dierkx 2002). With 34 children per classroom and 8 classrooms per school, this would total to 272 children per school for one stream (544 children for 2 streams, 816 children for 3 streams) with total enrolment.

The reality is that enrolment in Kenya decreased from 95 percent in 1990, to 88,8 percent in 1998. UN statistics puts enrolment at primary level at 76 percent in1999 (Wachiri 2001; Mathiu 2002). This means that from 1 064 000 children of school going age, only 808 640 children in Nairobi will find a place in a school, and only when the schools have actually been built. Thus, a remaining 269 54 7 children will be left out. With the total number of schools (public and private) in Nairobi at 389, the average annual growth of public primary schools (±3, 1 5%t) can simply not meet the increasing need for more pupil places.

The average classroom measures 4,80 by 7,50 metres (36 m^2), times 8 classrooms, times 20 000 (cost per m^2, low-cost, double storey) and this comes to Ksh5 7 60 000 per school. There will be a need for an additional 602 schools (with 76% enrolment) and 915 schools (with 100% enrolment) from 2000 to 2010. The Kenyan Government allocates 57 percent of its education budget (2000) to primary education, but over 90% is earmarked for teacher's salaries and administration. Hence, the budget is not adequate to build sufficient schools to meet current and future demands in Nairobi.

Table 2: Building rates in Nairobi of school building types (contractor built) for 2000

Building type/Mode of building	Costs per square metres (m^2) in Kenyan shilling
Community-based*	4 000,00
Intermediate technology	8 000,00
Low cost, low rise	12 000,00
Low cost, double storey	20 000,00
High cost, low rise	24 000,00
High cost, double storey	28 000,00

Source: *The Quantity Surveyor*, March 2000. Building Materials Prices, *Journal of the Institute of Quantity Surveyors of Kenya*, Nairobi]* Community-based planning, design and building (without a contractor)

The alternative options are intermediate technology (contractor-built), and community-based planning, design, and development with the assistance of a local school resources advisor. For both options appro-priate guidelines and training manuals have to developed and admin-istrative and legal procedures for obtaining loans and licenses have to be evaluated. In addition, current building codes have to be reviewed and intermediate building standards have to be developed enabling local communities to build schools with the more affordable, sustain-able, and innovative building materials that have been developed (stabilised soil block, agro-waste building materials, etc).

Cost estimates for school construction, intermediate and community-based (Nairobi)

Intermediate. A sustainable and inclusive primary school located in the Mukuru-Kayaba slum was designed in collaboration with school children (Dierkx 2002) (*Figure 5*). The round floor plan of one classroom has a wall/floor ratio of 0,363 (unit: 11 m diameter), as compared to that of a square (0,410). Total interior space is 142,5 m^2. The veranda (3 m deep) is 150,0 m^2 for extra learning space. Circulation space is minimal (entrance, 18,5 m^2). Total construction cost of a classroom is: Classroom (292,5 m^2), times Ksh8 000/m^2, equals Ksh2 340 000 (US$29 250). As it is intended to have 3 shifts of 26 children per class (78 children), the area per pupil will come to 292,5/78, which is 3,75 m^2/pupil. Hence, the cost per pupil place will come to 3,75 times 8 000, which is Ksh30 000. For conventional construction methods this would range between Ksh45 000 to Ksh75 000. Prices are based on contractor-built construc-tion and architects' fees.

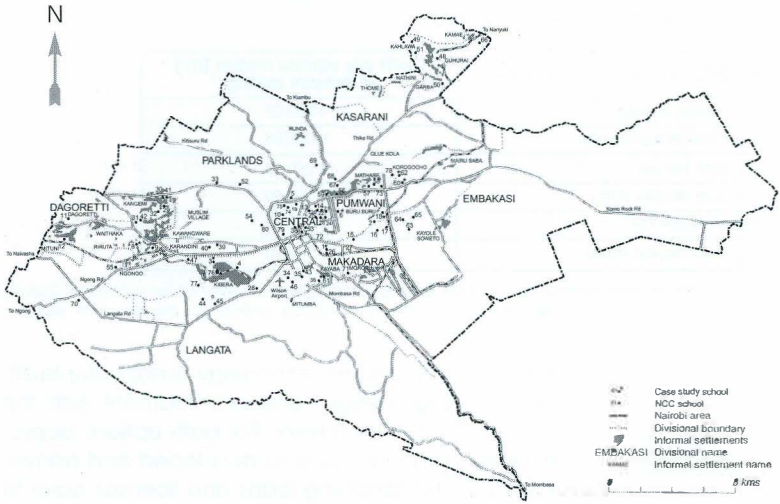

Figure 1: A map of Nairobi's schools (Dierkx, 2002:68)

Community-based. However, by using agro-waste, recycled-and natural materials, (community- designed and built) with no high transport and import costs, costs will be reduced (with acceptable quality of finish) to an estimated Ksh3 000-4 000/m². The construction cost of a learning unit will come to between Ksh0 8 78 and 1 1 70 000 (US$10 968-14 625). Cost per pupil place will come down to Ksh 15 000. Hence, school construction will be more within the reach of local communities. The aim is to stimulate community participation and small-scale business development as a poverty reduction strategy.

Methodology to determine the need for inclusive schools

The conditions for school-going children growing up in Nairobi, and the many constraints and barriers to the financing and implementation of educational facilities, led to the need for inclusive school development that was found in the survey, assessment, and workshops.

Field survey in Nairobi

From March to September 2000 a field survey was conducted to gain insight into the complexity, scale and depth of the problems concern-ing the environmental conditions of Nairobi City Council (NCC) Primary Schools. The field survey took place in the Nairobi district that spans 1 64 000 square kilometres, which is divided into eight political districts: Makadara, Embakasi, Dagoretti, Kasarani, Central, Parklands, Kibera, and Pumwani (*Figure 1*). To select schools a comprehensive directory was complied of as many of the 240 registered NCC primary schools as possible. By way of simple random sampling 1 0 schools were selected from each of the eight districts, for a total sample of 80 schools.

A questionnaire, a children's school design workshop and baseline assessment served as the main instruments for collecting data. Other data collection methods included observations; the recording of a documentary (a video about the physical state and environmental conditions at NCC schools), and informal interviews.

The questionnaire

All 80 schools in the sample were included in the questionnaire, which included open- and close-ended questions. The respondents who completed the questionnaire were head teachers (38 men, 42 women). The questions addressed the following issues:

- The environmental state of the school and school grounds including hygiene and sanitation, physical condition, maintenance, and human comfort level – and their relation to school health
- The community members' access to and knowledge of inclusive school environments and sustainable development and their relationship to education
- The community members' perception of technologies and materials used in schools.

The children's design workshop

The aim of the children's school design workshop was to discover the aspirations of Nairobi children regarding the development of inclusive schools. Eight schools participated in the workshop (one from each political division, the same schools as for the baseline assessment). The age group of the pupils was 13-14 years (standard 8). The total number of students participating was 80 (10 per school). The arts and crafts teacher was requested to select the brightest or most creative pupils, or a combination of the two. The eight schools were selected on the basis of intensity (information-rich case), comparable case (adding

confidence to findings), and multiple cases (adding confidence to find-ings). The schools represented the full range of socio-economic divisions in Nairobi: high-income, residential estates (Buru Buru primary school); middle-income (Toi primary school); low-income (Joseph Apudo prima-ry school, New Eastleigh primary school); semi-rural (Riruta Satelite primary school); squatter settlement (Mukuru-Kayaba primary school); and inner city slum areas (Korogocho and Wangu primary schools). The arts and crafts teachers and standard 8 children of each school received verbal instructions and a specially developed A4 poster that explained the format of the workshop.

During the workshop, the children were to design safe, healthy, and inclusive learning environments for a primary school in Nairobi, named a SHE-School (safe, healthy, and environmentally inclusive). The work-shop poster defined safety, health and environmental consciousness, described their importance for schools, and set specific questions for the students to consider. Working with teachers, the students were asked to make sketches and drawings of their schools, and to write a short essay explaining their impressions of the school and school grounds. The essays and sketches were made during the arts and crafts lessons and finished after school hours (after 15,00 hrs).

Baseline assessment

After running the questionnaire and the design workshop, with help of a research assistant, a Kenyan), an in-depth assessment was conducted in eight schools (same schools as for workshop) to find out if the answers to the questionnaire were 'honest' answers (especially the ones relating to sanitary, environmental and technological (state of school) conditions). The baseline assessment analysed the general technical condition of the schools and their grounds; degrees of crowding in the classrooms; conditions of toilets, sinks and water sources; conditions of the physical plant of the schools and the technology available; types of building materials used and their condition, and availability of climate control.

The research assistant did the final assessment when it came to sanitary and environmental conditions (to exclude the Western eye). The techni-cal state of the school buildings and school ground was assessed by myself, viz the state of construction, materials used, landscaping, green groundcover, type of toilet, classroom comfort-heat, humidity, crowd-edness. The assistant assessed the dust, smell, and the noise levels.

A list of questions and tables was prepared that followed the questions of the questionnaire, very closely but, at times were more detailed (giving more technical options). Some added questions were the ones

on classroom size, crowdedness (my assistant and I were counting), access and availability of educational facilities (computer, typewriter, library books, etc), bio-climatic comfort measures (passive and active means). Hence, all sources for data came from direct, empirical observation in the schools.

The main findings

The questionnaire data with SPSS 1 0,0 was analysed, using basic statistical methods, frequencies and correlations, to investigate linkages between health, environment, municipal services, information dissemi-nation on sustainability, perception and choice of technologies, and other factors outlined below. As a result of the questionnaire, workshop and baseline assessment, correlations was found between student health and several adverse environmental conditions: flooded school grounds; excessive noise (traffic, industry); excessive odour (garbage dumps, industry); solid and fluid waste (small-scale enterprises, broken sewers); polluted rivers (solid, fluid, toxic waste); poor physical state of the school, and poor municipal services. Adverse environmental condi-tions occur in combination with poor sanitation and unsuitable drinking water from unclean sources (water vendors). The correlations I found are not very high, but the impact of these conditions, in various combina-tions, and the strength and magnitude of the correlations with health, need further investigation.

The data also revealed that information about sustainable building technologies is not readily available to communities. The development of inclusive pilot schools could increase the awareness, understanding and application of such technologies to school development by local communities. The introduction and use of sustainable building materials over conventional materials will, according to the respondents, depend on the following criteria: that ease of maintenance, affordability, durability, availability, and appearance are equal or comparable to what is already used, and that guidelines for use are clear. The respondents do not favour the city council school plans. They wish to see more variety, flexibility, affordability and ease of maintenance. They also favour community participation and control of the design process, in cooperation with architects.

Workshop results

The submissions were diverse: On the whole, the essays were more informative, giving more details than the drawings and sketches. The submissions focus on independent classroom and other functions, since the staffroom, the classrooms, the library, toilets and the kiosk are all single buildings. In addition, there are details on sports facilities (tennis, badminton, swimming, and running), playground space, outdoor lunch areas, storm drainage, and secure fencing. Some show considerable detail on environmental aspects: composting pits; vegetable and flower gardens; fishponds; rainwater harvesting, and trees, shrubs and other landscaping, but, only in respect of the Wangu and Buru Buru primary schools.

The children's essays

The essays revealed much information. Most participating children were explicit about the unfavourable conditions for them inside and outside the school: excessive noise and smell, unclean sanitation, no shade trees, flooded playgrounds, gloomy and poorly maintained school buildings, unsafe roads (no pedestrian crossings, or traffic lights, speed-ing cars), and violent street children, were among the most mentioned conditions. Some contributions on the conditions in the schools and the desired Inclusive School follow below:

1) The school is not secure because of the nearby factories, bars, and many destructive things. The school is also affected by noise pollution and sound pollution. It is not very well ventilated and built. It is unsafe for the children because there are roads near and cars will easily knock down the children. The bar, which is near makes the children less attentive in class. The school does not have clean toilets, so the school smells. It is also not well maintained. It does not have trees, so it is very ugly and unwelcoming (Julia Muthoni, 1 3 years, Nairobi South Primary).

2) This is our school. It is near a shopping centre. It was built along the road where there is noise pollution. Some buses play music in and when they pass near our school the volume is very loud and when pupils are in class they cannot concentrate. Near our school there is sewer and air pollution from the burning com-post pit. There is a big market at which we are not allowed to buy things to eat and drink because they are made with non-boiled water. Inside the school there is no swimming pool, no water, and no fishpond. It has very few classrooms and toilets. The toilets are very dirty because there is nobody to clean

them. The school has no trees. It has no fence and so anybody can get in (Christine Muranga, 13 years, Nairobi South Primary).

3) In my school, we had a broken sewer, which was flowing behind our school. The smell was so bad that we could hardly read and the teacher could hardly talk. In my SHE-school I would like a proper drainage system. My school has a main road nearby, which leads to town. We are affected by noise pollution, especially in the middle of an examination. The SHE-school I talk about would be quite a distance from the main road and it would be located somewhere quiet and peaceful. Whenever we come to school very early ... we usually find the lights on, that is around 6,25 a.m., but after about five minutes we are left to study in total darkness until there is enough light from the sun. I wish for a generator in our school. Sanitation is also important in a school. The toilets should be cleaned spotlessly ... The sinks should be firm and have hot and cold running water. The water closet should be flushable. The classrooms should be big enough and well spaced and should have windows and curtains. The blackboard should be about 20 feet. The whole classroom should be painted white (Sheila Nyacuru Kihonge, 13 years, Buru Buru I Primary).

4) The toilets should be well built and should have water closets to prevent outbreaks of communicable diseases, e.g. cholera. There should also be compost-pits for garbage disposal. The school environment should be conducive to learning and not too near the city centre. There should also be trees in the school compound and in the neighbourhood to regulate and freshen the air. SHE-school should also be well equipped with both learning materials and facilities e.g. classrooms, libraries, laboratories, and books to enable the pupils to have a wide choice of subjects. The school should also have religious teaching to guide the pupils in their moral behaviour. The school should also have teachers who are friendly. This will help the pupils to consult with the teachers every now and then (May Gathoni, 14 years, Buru Buru I Primary).

Case: Inclusive school design at the Mukuru-Kayaba squatter settlement

This section contains the design of an inclusive primary school at Nairobi's Kayaba squatter settlement (*Figures 2, 3 & 4*). This design will replace the existing Mukuru primary school, which faces serious problems of safety, health, and environmentally degraded conditions, in and around the school.

Context of the school environment

The Mukuru primary school lies in the Kayaba slums in Nairobi's industrial area. The residents of Kayaba work in the Industrial area or engage in informal activities. The school is built on a 1,46-acre plot (5 945 m^2, 70 by 85 m), and began as an informal school in 1985 with 45 pupils. Since then the school has grown to 1 200 pupils and a staff of 36 teachers including the head teacher. The children are AIDS orphans, street children, or slum dwellers. This requires a lot of dedication from the teachers. The pupils are attracted by the daily lunch at the school donated by the World Food Programme. Many children are addicted to glue sniffing and in need of rehabilitation.

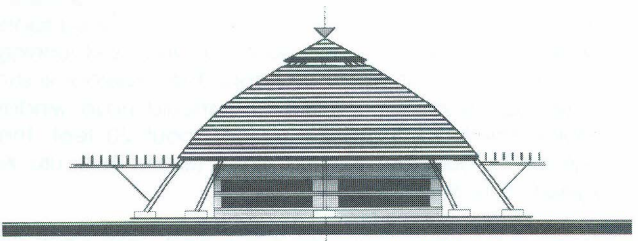

Figure 2: Design of an Inclusive Elementary School: typical elevation (Dierkx 2002:214)

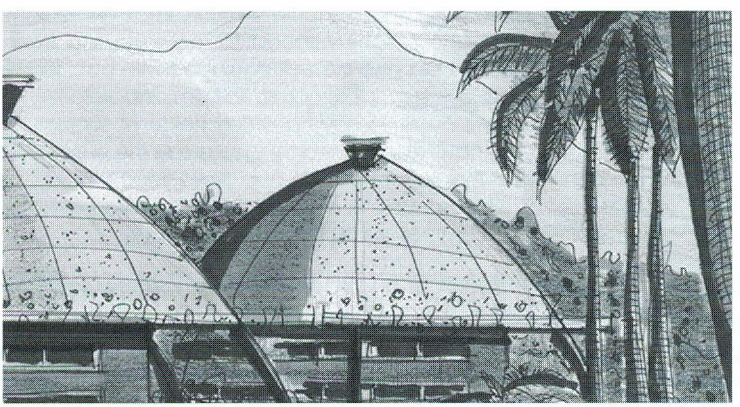

Figure 3: View, Mukuru-Kayaba Primary School, at the Kayaba Squatter Settlement, Nairobi (Dierkx 2002:212)

The current state of the school

The classrooms measure roughly 42 square metres (6,00 m by 7,00 m). Galvanised corrugated iron sheets are used for walls and roofs. There are no glazed window frames, but light enters via openings high in the walls, which are secured with mesh-wire for safety. Most classrooms are orientated with long elevations running northeast to southwest. Hence, the children feel very uncomfortable and lack concentration due to high temperatures building up inside the classrooms. Simple and affordable solar control measures to provide shade or cooling, like trees, verandas, trellises, ceilings, double roofs, and cross ventilation, are absent due to design errors, lack of knowledge, and financial constraints. Furthermore, the classes are overcrowded (up to 60 pupils per class), who sit on timber benches that accommodate four pupils. The floors are made of cement but are potholed. The classrooms have no artificial light, which makes doing homework difficult as their homes often lack adequate lighting as well. Some classes have reed-mat ceilings and soft-board as inner walls, but they are in a very poor state. The classes have a lockable cupboard to store away teaching materials. Members of the community often steal firewood and other items from the school.

In addition, there is no playground for sports, extra-curricular or other activities. Many pupils have no uniform and shoes. The drainage system is of poor quality; the sewage passes through the school grounds, which makes the place smell foul. The sewer near the school poses a health hazard as waste from the slum floods the school almost on a daily basis especially during the rainy season. There are pit latrines, but they smell excessively due to the high toilet/pupil ratio (1:70) and a lack of water. The atmosphere in the classes is hot, gloomy, dusty, and uncomfortable.

The baseline assessment of the school revealed that environmental conditions such as smell and flooding levels are totally unacceptable. Noise and dust levels are too high. Classroom comforts like temperature and light are not acceptable. The school's technical condition is very dilapidated. Construction, layout, school appearance, maintenance, and the state of the fence and drainage are all very poor. The state of the toilets is acceptable, as they were built recently through foreign NGO funding.

Narratives and community-based architectural programming

Data from the initial field survey provided the assessment we used to determine Mukuru-Kayaba's current problems. I helped the Kayaba community members use the SANA narratives (see note 1) to describe their needs and desires for their school. As an example for the school users, I initially chose a set of relevant narratives for the planning and

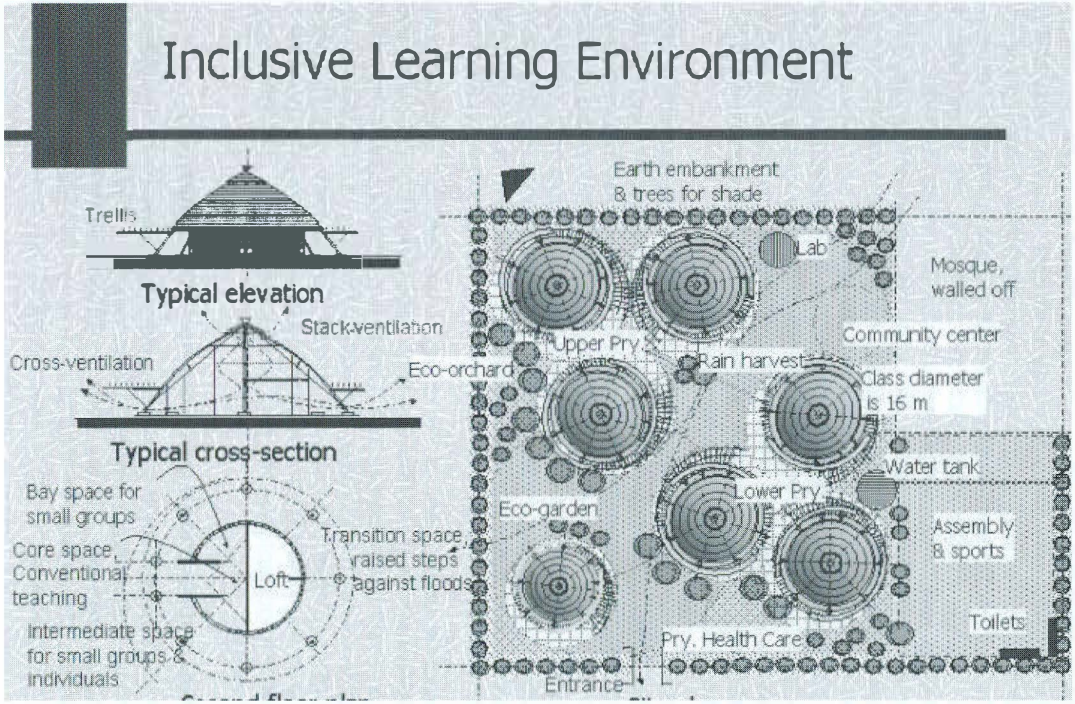

Figure 4: Cool schools for hot suburbs: a site plan of the Inclusive Learning Environment for the Mukuru-Kayaba primary school (Dierkx 2002:213)

design phase of the case study (*Table 1*). The narratives divide the task of school development into a series of small steps, working toward inclusive development. The Mukuru-Kayaba school was one of the schools where the baseline assessment was carried out. Together with the data of the questionnaire, the baseline data formed the basis for the selection of narratives, which titles are listed in *Table 3*.

Table 3: Selected narratives for the Mukuru-Kayaba primary school

Narratives forming a whole story of community-based inclusive school development		
1. Secured surroundings	56. Guidance & directions	81. Helpful light access
4. Income generating activities	59. In-between-teach space	82. Safe storage
5. Local community network	64. Positive classrooms	88. Adaptable spaces
11. Community schooling	65. Individual coaching	90. Affordable spaces
12. Safe school environments	66. Small group activity	97. Choice of technologies
14. Positive place repair	68. Eating & preparing	100. Low-environ. impact
17. Comfortable siting	70. Serene reading	114. Sheltering roofs
22. Harvesting rainwater	71. Pleasant assembly	122. Affectionate colours
28. Neighbouring structures	72. Fine arts & crafts	124. Classroom size & form
29. Shading and filtering trees	74. Music, dance and singing	126. Layouts & dimensions
34. Eco-impact on schools & users	75. Healthy sanitation	128. Affordable methods
39. Sound: landscape & structures	76. Management domain	134. School character
40. Smell: site, production, dumping	78. Locating entrances	137. Cost control guidance
51. In- and active leisure	79. Placing openings	141. Daily use of school
52. Outside learning	80. Ventilate cross & stack wise	

Source: Dierkx 2002:175-216

After a 'diagnosis' with the narratives in mind, the 'treatment' phase of the Mukuru-Kayaba program followed. The participants in the exercise were 10 standard 8 pupils of the school (the same as for the workshop). No staff member was included. They worked together outside the school. I had arranged workspace outside the Kayaba squatter settlement in Nairobi where we met during the school holidays.

They were provided with the basic information of the school, maps, and the brief: so many children per class, so many classrooms, space for sports, toilets, outside spaces for leisure, and learning, a school garden, and other facilities. The idea of the narratives was explained; how they could form a story for developing a school. This process of assisting in future has to be carried out by a local school resources advisor.

All in all they agreed with the initial choice of narratives, only they wanted to stress even more the importance of safety and of the environmental conditions, particularly, drainage, flooding, solid waste, noise, tree planting and shrubs in and around the schools. In addition, the classrooms had to be flexible enough so that a conventional arrangement, with rows of benches and a new circular arrangement (so to speak an informal or traditional setting), were possible.

This resulted in focusing more on the adaptability of the classroom spaces, thus adding the narratives 64 (positive classrooms), and 1 24 (classroom size and form). Narrative 82, safe storage, was also added. After one week the results (many sketches and ideas) were to arrive at a more conceptual proposal of an inclusive school for Mukuru. The concept design of the construction was done by myself and the materials for the roof, walls and the construction was decided on in con-sultation with local artisans. All materials had to be local, and new or second hand. Involvement of the local community in making the materials and building the school was one of the criteria.

Conclusions of the case

The children eventually developed a real, workable design for a new school on the current site, remaking the currently dangerous and unwelcoming place into a healthy, sustainable and ecologically oriented school that meets the needs of the whole community. What evolved from the process was a plan for an inclusive school in which that the following aspects contribute to its inclusiveness:

- There is application of local materials in a new way, or upgrading of them with innovations in local building materials production to be used for the construction of the school
- There is spatial organisation and extension of the learning environment beyond the conventional nucleus classroom onto the school ground, hence, offering more opportunities for learning
- The whole person and the contextual nature of learning is acknowledged
- Interventions that offer an alternative to street life for children are provided, which help to reintegrate them into society in productive, healthy ways
- Students' basic needs for food, shelter and care are met, and they are offered personal development and opportunities for participation in the community

- The sustainable architecture is synthesised with the surrounding landscape and climate
- The participation and control of the local community over the school project is ensured from the start: community groups, small-scale enterprises, school users, with the assistance of a local school resources advisor
- Architecture is used as a tool for learning (eco-orchard, eco-garden, water harvesting project, solar power/water heating project, sciences lab, etc)
- Finally, there is acknowledgement of the interconnectedness of all life forms, emphasizing peace and harmony among all Kenyan communities.

The development of the full learning programme (architecture as learning tool, phased-program for re-socialisation, basic life skills, income-generating skills, etc) will be left to the local community, school management, and local authorities, to be worked out by them in detail.

Conclusions and lessons for schools in South Africa

Educational policies are almost unanimous in their aim of education for all (EFA) in the coming two decades, as concluded at the 2000 UNESCO-Dakar World Education Forum. This forum stressed the need for safe, healthy and environmentally inclusive educational facilities as discussed in the Introduction and section of the Local Setting. Yet schools in Africa do not exist in a vacuum. They are a vital part of the physical urban infrastructure and social setting of their neighbourhoods. Due to their public nature, schools can play a guiding role in spreading information on sustainable development and the application of sustainable practices (*Figure 5*).

The learning programme could involve the school and landscape to act as a learning tool for children, staff and local community. Public services like health care, community theatre and adult education programmes could be integrated into the programme. Initiatives for sustainable school development could be extended to other social infrastructure planning. Learning from 'best practices' elsewhere could be useful in this respect. The following main conclusion and implications below indicate which areas need action and further research at all levels.

In contrast to current practices, and the received literature, affordable and, sustainable school development is an appropriate option for authorities and communities in Nairobi. The issue of providing sufficient schools, to keep pace with the growing group of children of primary

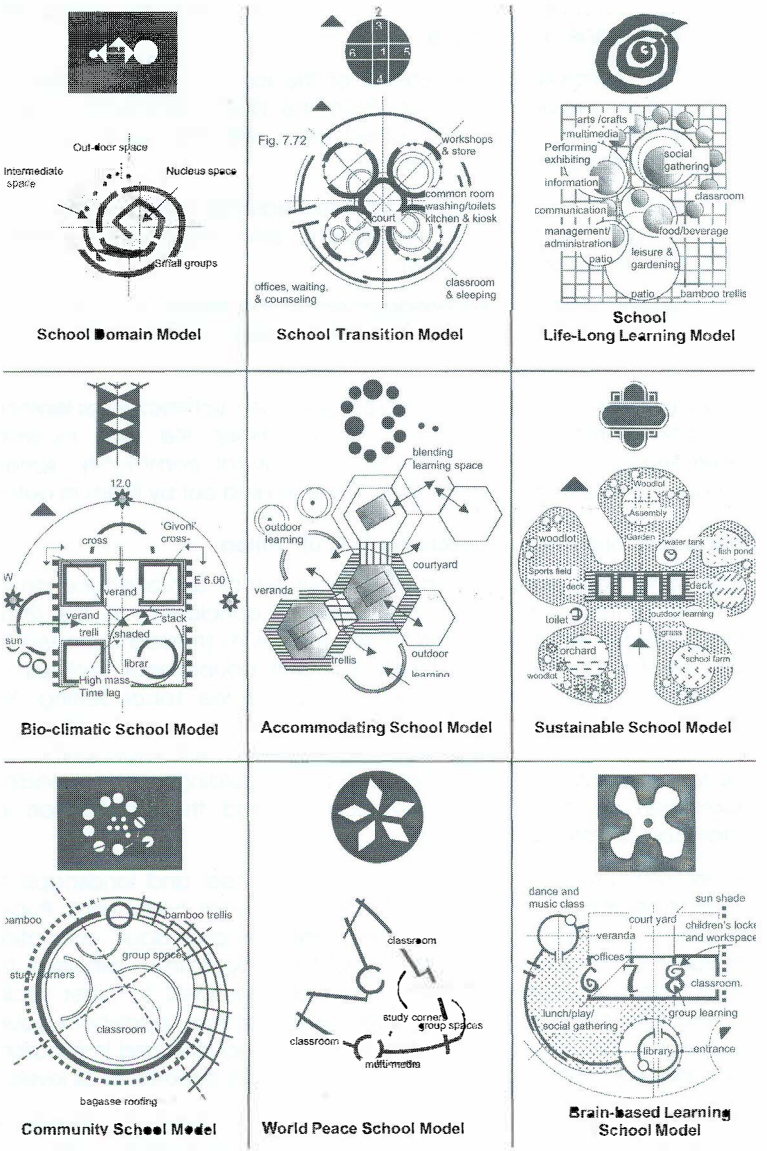

Figure 5: Concepts for physical educational facilities in Nairobi with the Sustainable School Model in the middle, to the right (Dierkx, 2002: 128)

school-going age, is plausible, and should be addressed in a construc-tive and effective way. South Africa is working towards the implementation of Curriculum 2005, together with new learning and teaching methods, new technologies, decentralisation of education and shift of responsibility to schools, may be a unique chance to implement the concept of inclusive school development in conjunction with the local communities drawing on the environment and local resources for learning.

The lessons from the Kenyan experience, as discussed in the introduc-tion, and the sections on growing up in Nairobi and the findings of the survey, meant for all stakeholders, are that in South Africa policy-and decision makers, professionals and the general public should focus on:

- Realisation of sustainable pilot schools
- Development of guidelines and standards, and revision of the building code
- Development of schools respecting the local context and train-ing of local school resources advisors
- Evaluation of existing school prototype plans
- Promoting a culture of maintenance and development of new forms of partnership
- Strengthening community participation and control
- Strengthening notions of community ownership and identity
- Financing school development and refurbishment programmes for existing schools
- Strengthening local physical planning and building research
- Reducing disparities among local communities, safeguarding environmental interests
- Promoting poverty eradication and small-scale enterprise development.

The findings of the survey show the need for more detailed and clearer dissemination of information on sustainable (school) development. Hence, sustainable pilot schools should be developed as 'best prac-tices' to increase the understanding and use of such practices with local communities and authorities. Furthermore, guidelines, procedures and standards regarding school development should be updated and manuals and programmes for role-players at local community level should be prepared. Building standards should be more performance and function oriented instead of focused on a few materials in the building code.

In addition, the development of inclusive school architecture should be based on the geographical, socio-economic and cultural context of local communities. Local school resource advisors should be trained to assist with, the preparation of school development plans. Existing school prototype plans used in sub-Saharan Africa should be questioned as they have been found inflexible and not accommodating enough for the use of innovative learning methods (large group, small group, and individual learning). They are not affordable and difficult to maintain by the school management teams, and, finally, they do not allow for the integration of the natural environment with the classroom, hence offer-ing multiple opportunities.

Furthermore, 'maintenance' of the urban (school) environment is seri-ously lacking. Therefore, a 'culture of maintenance' should be created at all levels in schools in the formal and informal sectors, and new forms of partnership among stakeholders should be developed. Involvement of role-players at community level should be promoted: parent teacher associations, school management, small-scale enterprises, etc.

Moreover, as discussed in the section on 'school need', it will be vital to find ways to finance the expansion of schools to meet the increased enrolment in schools, and to finance the refurbishment of primary schools. Likewise, strengthening local building research institutes and establishing research agendas to carry out studies to improve tradition-al technologies and blend them with appropriate, and advanced technologies will have to occur. The local capacity of the construction sector, research and science education at all levels will have to be prioritised. More effective links between universities and the private sector and the development of human resources will have to be promoted, amended with the national development goals of Kenya.

Finally, as presented in the introduction, appropriate measures will have to be taken to reduce disparities in communities in Nairobi and regions in Kenya in general, by providing logistical and material support to disadvantaged communities (residents of inner-city slum and squatter settlements) and to guarantee that all measures taken fall within the strategies of protecting the environment, promoting the eradication of poverty and stimulating small-scale enterprise development.

Further research

Significant will be the development of quality assessment scales and grassroots development indicators for school environments using rapid assessment methodologies. Sustainable planning, design and building guidelines and manuals for schools, which can be utilised with ease by local communities in non-conflict, conflict and post-conflict situations

will have to be developed. Likewise, the development and refinement of community-based architectural programming and school development methods, and research into the synthesis of the knowledge of designers and expertise of educators and ecologists, in relation to linking these elements to architectural design considerations for school environments, will have to occur.

Finally there must be research into physical learning environments for project-based learning space (active participation), and studies on school playgrounds and ways to transform them into learning landscapes: the use of learning landscapes as teaching tools for ecology, science, maths, language arts, social studies, the arts, health, extra-curricular activities and stewardship.

References

DAILY NATION

1999. Slum school facing logistical hurdles. Art of Blackboard Feature. Nation Centre, Nairobi, Kenya.

2000. Alarm over new schools. Art of Blackboard Feature. Nation Centre, Nairobi, Kenya, April 10th 2000

2000. Why education reforms have failed in Africa. Letters. Nation Centre, Nairobi, Kenya, April 17th 2000.

2000. New targets set for basic studies. Blackboard Feature. Nation Centre, Nairobi, Kenya, March 20th 2000.

2000. It's a dangerous journey to school. Art of Blackboard. Nation Centre, Nairobi, Kenya, July 24th 2000.

DIERKX, R.J.[1]

2000. SHE-Education: safe, healthy, and inclusive environments: three cases of Wangu, Mukuru, and Korogocho primary school in Nairobi. Proceedings. Sustainability Beyond. Eindhoven: University of Technology, The Netherlands.

DIERKX, R.J.[2]

2000. Nairobi narrative: a tale of sustainable schools in a devel-oping dual city. Proceedings, Urban Futures 2000. University of Witwatersrand, Johannesburg, South Africa.

DIERKX, R.J.

2002. Cool schools for hot suburbs: models for affordable and environmentally responsive schools in Nairobi, Kenya. PhD thesis. Eindhoven: University of Technology Publications, pp. 69-72, 105-113.

2001. Smart schools: seeking prototype sustainable community schools for Nairobi's children. Final Report of Schoolconsem IV, UNESCO/BREDA, Dakar, Senegal, pp. 40-50.

EAST-AFRICAN STANDARD

1999. Street gangs unleash terror on city school. Nairobi, Kenya, August 21st.

KOECH, D.K.

1999. *TIQET: Totally integrated quality education & training*. Nairobi, Kenya: Government Printers, pp. 209-219, 221.

LILLIS, K.M.

1992. Urbanization and education in Nairobi. *African Urban Quarterly*, Nairobi, Kenya, 7(1-2), Feb-May .

MATHIU, M.

2002. Commentary on education. *Daily Nation*. Nation Centre, Nairobi, Kenya, January 16th 2002.

MULLER, R.

1986. World core curriculum manual. Robert Muller School, Arlington TX, USA. Internet: <http://www.unol.org/rms/>.

NJUGUNA, D.G.

1997. Diffusion of bio-climatic building design techniques in Kenya: impediments and opportunities. *Habitat International*, 21(4), pp. 347-359, UK: Pergamon Press.

TAYLOR, A.

2000. Programming and design of schools within the context of community. Internet: <http://newhorizons.org>, pp 4-8.

UNCHS

1996 An urbanising world-global report on Human settlements, Nairobi, Kenya, pp. 444, 451 .

2000. Street children and gangs in African cities: guidelines for local authorities UMP, Work. Paper 18. Ochola L, A Dzikus, F Vanderschueren (eds). Nairobi, pp. 56-69.

UNCHS

2001. Cities in a globalizing world: global report on human settlements 2001. London: Earthscan, pp. 14, 271.

UNDP

2002. Human Development Report 2002, pp. 152, Internet: <http://www.undp.org>.

UNDP, UNCHS & WORLD BANK

1994. *Rapid urban environmental assessment.* World Bank, USA, pp. 1-5, 74-76.

1994. *Toward environmental strategies for cities.* World Bank, USA, pp. 1, 84-94.

UNESCO

1977. Buildings for school and community use: Five case studies. UNESCO, Paris.

1979. Building community schools – an analysis of experiences. Paris.

1996, Inclusive schools & community support. Program Report 1997. (ED-99/WS/19), UNESCO. Paris, pp. 31-34.

1997. Guidelines for the design of centres for street children. Paris, pp. 74-76.

1998. World Education Report 1998. UNESCO. Paris.

2000. Dakar framework for action: EFA, meeting our collective commitments. World Education Forum, UNESCO. Dakar, Senegal, pp. 8-10.

2001. Schoolconsem IV: 4th Regional consultation on school construction and equipment. UNESCO/BREDA-Dakar, 6-10 February 2001, Dakar, Senegal, pp. 35-36, 40-50.

2002a, EFA Global Monitoring Report. Is the world on track. UNESCO. Paris, pp. 13-15.
2002b. Non-violence in education, (ed) Muller J.M., UNESCO, Paris, pp. 55-59.

WACHIRI, D.

2001. Alarm over new schools. Blackboard Feature, *Daily Nation*. Nairobi, Nov. 26th, 2001.

WORLD BANK & UNCHS

2000. Cities alliance for cities without slums (summary edition), UNCHS, Nairobi, Kenya, pp. 1-9.

WORLD BANK
2000. Poverty fact sheets. 31 May 2000,
Internet: <www.worldbank.org/html/extdr/pbpbpoverty.htm>.

WORLD RESOURCES
2000. World Resources 2000-2001: People and ecosystems: The fraying web of life. Washington DC: World Resources Institute, pp. 45-47; 54-55.