View west along the Lovegrove Canal onto the Mariamma Nagar settlement in Worli, Mumbai.
Summary

‘A learning architecture’ is a practice-led architectural research project; broadly it is a study of the pedagogical links between environment and learning in areas of scarce resources, driven by live design-led experimental research in Mumbai into how the designed environment can help primary school children to learn/concentrate/play.

The fabrication of small-scale situated interventions using a local heritage of design languages follows a series of participatory design workshops held with the NGO Muktangan’s school community.

The wider aim of this project is to propose experimental strategies for municipal schools that cater for children from low-income families and who live in informal settlements in particular, to improve their learning environment affordably.

The RIBA ICE McAslan Bursary 2012 enabled this project to develop an angle on how to make learning environments healthier, forming the first year of practical research and the beginning of a larger study, with a broader aim to bridge the gap between research and practice in architecture.

‘(... in order to do something big – to think globally – one starts with something small and one starts where it counts.’ Nabeel Hamdi, Small Change
Introduction

In 2011 I moved to Mumbai to begin an independent research project studying the architecture of learning environments in informal settlements, and how art, craft and performativity can interplay. My interest in this subject stemmed from both practice and teaching, transforming into a desire to integrate research into practice in a more active manner.

‘A learning architecture’ is a combination of pedagogical involvement in design for the protagonists (Lovegrove School Children) and involvement of local crafts-people and manufacturers in creating innovative interventions for municipal schools, in what aims to be a reciprocal-active learning practice.

With the aim to show governing powers that municipal schools can be precisely and affordably improved by design, in this project the Architect acts as a facilitating and activating development practitioner. Sustainability in its most general sense plays a large role in the design strategy, with a broader aim that projects could be self organized in the future.

Involving pupils in thinking about their environment could have an impact on the quality of future school environments. Together we are demonstrating that through critical thinking and practice we can with very little make positive changes to the spaces we live in; pupils could learn to ‘(...) confront reality critically, simultaneously objectifying and acting upon that reality’ within a ‘problem posing education’ (Paolo Freire).

This project is as much about developing a process that involves children in designing or re-designing their environment as it is about producing designed objects/interventions, and exploring the wider pedagogical and social impact of ‘designing with’ as opposed to ‘designing for’.

View north-east from Lovegrove school onto Worli, with a disused mill in the foreground, and growing residential and commercial buildings behind.
Government schools in India/Mumbai

Today, in India the government is the largest provider of primary education and according to the 2009 Right To Education Act, free and compulsory for children aged from 6 to 14 years; however other providers of education exist and range from expensive private institutions to NGO-run free and fee paying schools.

After visiting some government schools in Mumbai I noticed in many cases there was little provision for children to play or dine, nor was there much space for staff; premises were generally lacking in resources, maintenance and decoration. Municipal classrooms were often furnished with old-fashioned solid wood desks facing a single blackboard.

The range of education provision in Mumbai (including curriculum, teaching quality and built environment) illustrates the contrasts that exist in India: On the one hand there are free government schools such as Lovegrove School (the focus of this project), and on the other, schools such as the Shri Dhirubhai Ambani International School an international school costing 50,000INR of fees/year for primary education.

In general, government school education in India currently uses the ‘banking’ system, or ‘learning by rote’; the Brazilian educator and philosopher Paulo Freire sees this method of teaching as filling ‘recepticles’ and explains in his work *The Pedagogy of the Oppressed* that ‘problem posing education’ allows pupils to develop critical thinking while in contrast ‘banking education inhibits creativity and domesticates’ children.

However, the progress of education development is being monitored: The Annual Status of Education Report (ASER), a document released every year by education NGO Pratham, publishes up to date statistics based on non-governmental surveys measuring enrolment, reading and arithmetic. In 2010 it stated that ‘nationally, 46.3 % of all children in Class V could not read a Class II-level text.’ And, in 2011-2013, the level deteriorated.

Currently around 72% of pupils in India attend government schools, whereas 25.6% go to private schools. There is a goal to achieve a student to teacher ratio of not more than 30:1, however this is difficult to track, and regular attendance (of children and teachers) is hard to ensure, but improving.

Jayanta Chatterjee sets India’s education system in a broader global context: ‘With a literacy rate of 75.6%, India compares poorly with not just industrialized nations, but also several much poorer economies such as Iraq (78.1%), Congo (81.1%), Kenya (84.2%), Vietnam (92.8%), Sri Lanka (94.2%) and Mongolia (97.5%). India now ranks 78th out of 123 countries, in terms of literacy, according to UNDP report (2011). India’s human development index is now ranked
134th out of 187 countries. We need to remember that there are clear differences among the terminology – literacy, education, knowledge and wisdom. Though some Indian policymakers wish to create a knowledge-based economy, in reality, India is stuck at the first phase itself, i.e. literacy. Primary and secondary education reform should be the top priority for India.’

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Language in school

In Mumbai, primary schools run either English, Hindi or Marathi Medium programmes. However, Hindi is frequently used in English medium schools as a translation and transition tool, and as a conversational language between pupils, teachers and parents. English seems to be more of an official school language and Hindi or Marathi used for the day-to-day.

The debate about language in Indian schools is longstanding: As Jandhyala B. G. Tilak explains in his work Education, Society and Development, ‘There is a peculiar kind of competition between regional language and English as medium of instruction (...). At the ideological level there is a kind of glorification of regional languages. At the same time from a practical point of view English education is seen as more useful (...). What is needed is to evolve a nationally acceptable language policy that promotes regional language and at the same time free from ethnocentric parochial tendencies. The small percentage of English-speaking population in India may support English as the most effective and useful medium of instruction. But the ideological position of viewing English as a symbol of colonialism or neo-colonialism and dependence is very much against a policy that accords supremacy to English. The same tendency operates to reject Hindi as the viable medium.’

Lack of funds

According to various recent media reports around 2-3% of the Indian population pays income tax: This would indeed explain some of the huge gaps in infrastructure, education, health care and social facilities. Insufficient funding is often to blame for poor quality of school buildings, low wages for teachers and scarcity of staff. But the main victims of this lack of social infrastructure are low-income individuals and families.

As Sen and Dreze remark in An Uncertain Glory: India and its contradictions published in 2013, ‘While the privileged are able to take refuge in private arrangements (expensive as they might be) the rest are deprived of essential facilities that ought to be available to all as a matter of right.’ They go on to say ‘Aside from diminishing the country’s prospects for participatory growth and broad-based development, India’s highly privatized and compartmentalized health and education systems (with very different opportunities for different social groups) also perpetuate social disparities – instead of reducing them, in contrast with health and education systems as well as
other forms of public support have tended to around the world.’ There is also a general mistrust of the government and widespread rumour that taxes collected do not enter official accounts. This has led to a situation where tax evasion and a huge black-market are the norm across social classes.

>>NGOs

In the midst of what seems like a neglected government education system, individuals have been and continue to form groups and organisations, taking progress into their own hands. The current positive actions of Non Governmental Organisations are countless, especially in Maharashtra, home to the largest number of organisations per state in the country. There are many NGOs relating to education, however some larger organisations stand out in size and success including Akanksha, Pratham, Aseema and Teach for India, most well known for their work setting up schools for children from low-income families. Some schools stand out due to their particular ingenuity with regards finding useable space in such a dense city: One of Akanksha’s schools is in a basement beneath the Nehru planetarium, there is an outdoor study area under a tree on a corner of Oval Maidan (the biggest green space in the city), Magic Bus travels to communities around Mumbai and Muktangan borrows spaces for learning (for instance half of a floor in a chawl building in Worli). In addition to more formal private or public/private schooling, individuals help educate disadvantaged children, setting up teacher-tutor sessions at home to small numbers of pupils.

It appears NGO schools are taking the slack for the government’s failing education system, and without their existence the situation would be considerably worse.
Muktangan School

The name Muktangan provides an insight into the nature of this school and organisation: ‘Mukt’ means freedom and ‘Angan’, the space in front of the home.

I chose to work with Muktangan because of their particular interest in experimental learning environments and architecture as a third teacher: It is an organisation that combines forward thinking and innovative pedagogy with thoughtful learning spaces and municipal free schooling for under-privileged children. Initially I started working with Muktangan school as a volunteer, helping in the community partnerships team, that communicates with and provides a platform for parents to discuss the children’s home life. I then developed this research project based on observations and conversations with the school community.

Muktangan is a free education programme (and NGO) in and around the Lower-Parel and Worli areas of Mumbai, that aims to provide a sustainable model of quality education affordably for low-income families, whilst developing teaching, pedagogy and the learning environment. The school provides education for children as well as training for its teachers.

Muktangan was set up by Liz and Sunil Mehta in reaction to the traditional aspect of education in India: They felt that although it was accepted that the education system needed to change, little was being done and attempts at reform had largely ignored teacher-pupil transactions, and that these were at the very heart of the educational process. In 2003, they started up one pre-school, with funds from their own Paragon Charitable Trust, training 7 women from the local community to be teachers. The school grew from there, becoming a public-private partnership with the MCGM (Municipal Corporation of Greater Mumbai) the year after. Every year a class has been added so that the first pre-school pupils are now in year ten.

Currently the schools are spread across a number of locations; some occupy spare floors in government schools, others unused spaces in residential buildings and even a small bungalow. The organisation offers an alternative to standard government schooling, focusing more on active constructivist learning, similar to that of the Montessori, Steiner or Reggio Emilia approaches.

The organisation is interested in how the environment can help children to learn and more specifically how classrooms (and other useable spaces) can be optimised to be part of the teaching/learning process. Teachers and pupils currently use demarcations on the floor as symbols of group sizes and colours on walls that refer to specific types of learning.

In pedagogical terms the school believes in constructivism and encourages cooperation over competition; the teacher is a guide and each child an individual. For this reason, each class of 30 children has 3 teachers, 1 for each smaller group of 10, groups that remain the same throughout the school year. These subdivisions occur often throughout the day in order to allow more focus...
and concentration: This highlights a belief that eye contact is an important part of learning and teachers are encouraged to be at the same level as children, sitting down in circles and facing each other.

At the heart of Muktangan’s constructivist pedagogy, are regular ‘Plan-Do-Review’ sessions: During these daily pre-school sessions, children have time to choose what they want to do, between the various themed classroom areas: home, drawing, making, music...

Currently, there are seven Muktangan schools that include various locations: GMP School (Globe Mill Passage, on the first floor only), BDD (residential chawl building on the first floor and in an adjacent Bungalow), Lovegrove School (ground and first floors), Ambedkar School (ground floor), Annexe (a chawl building opposite GMP, on the second floor), NM Joshi Marg school (first and second floors) and Sayani road (second, third and fifth floors). Each school has an independent relationship with its host and a separate head teacher.

The fact that Muktangan is growing and gaining reputation and importance within the education system is encouraging. The full teacher education programme is about to be accredited at national level, and the municipality sees the school as a genuine improvement to their own school provision.
Above: Muktangan school on first floor at BDD, using half a floor of a residential chawl building in Worli.
Below: Classrooms are flexible and children are in charge of re-arranging the class to suit activities. Right: Dishes in school kitchen.
Above: Muktangan Annexe School inhabits the top floor of an old residential building.
Below: Recycled drums used for make-shift play equipment. Left: A teacher walking along the Annexe school balcony access.
Above: Pupils and teachers taking a break in the shade at the Muktangan Bungalow School, BDD.
Below: Unused courtyard at Sayani Road School. Right: Use of corridors to store play equipment and bags at Sayani Road School.
Lovegrove School

Following a visit to each of the Muktangan school sites, Lovegrove School stood out for its geographical, social and environmental challenges, and therefore became the focus of this project.

This school largely caters for children living in the informal settlement Mariamma Nagar (92% of Lovegrove pupils), situated just across the adjacent canal to the east. At the moment staff consists of Muktangan trained women from the local community, some of which also live in Mariamma Nagar nearby. Chhaya Jadhav, the current head-teacher, moved to the school in January 2013, having previously been head-teacher at Sayani Road School: She is using a wealth of knowledge and experience to tackle the difficult Lovegrove school issues, particularly behavioural, health and language difficulties.

Shared premises

Lovegrove School consists of a five storey building owned by the BMC, that previously only housed Lovegrove Marathi medium government school. At first, the municipality allocated some empty classrooms to Muktangan, but now it inhabits the ground and first floors, with a library on the 5th floor. The general aspect and maintenance of the building is run-down and it lacks in regular and effective cleaning. Nevertheless Muktangan areas are bright and decorated with drawings and pictures; signatory green painted walls differentiate these areas from the rest of the school; an ‘outdoor playroom’ and a lobby currently provide play-space for Muktangan children, but it is mainly used as a store and the head-teacher/staff office/meeting room. Currently however, the school has no outdoor designated play space at all.

Access and security

The school is located directly behind Atria Mall, one of Mumbai’s first shopping centres; previously Lovegrove school had been a standalone building with a playground within it’s own compound on the current mall plot, which the BMC subsequently sold to Atria developers. The current Lovegrove school building was built as a replacement in the 1990’s, along with surrounding BMC employee residential accommodation (referred to as BMC Colony).

Children gain access to the school via a lane past the mall, down an alley decorated with torn images of beaches and palm trees. Security guards man both entrances to the compound, where many of the shared open spaces between buildings are used by residents to park cars and motorbikes.
Key:
1. Entrance to Lovegrove School
2. Paved raised water tank
3. Driveway to multi carpark and access lane
4. Access lane from main road
5. Security guard
6. Tuck shop
7. Lovegrove Canal
8. BMC residential buildings
9. Sub-station
10. Atria Mall roof
>> Noise pollution

The enclave is protected from the sound of heavy traffic by surrounding buildings, however on the opposite side of the canal the large-scale construction of a new pumping station is underway. Residents vehicles pass in front of the school to exit the compound and cause some disturbance to classes inside. Atria Mall has powerful air-conditioning units on the roof that make it difficult to hear in neighbouring classrooms and noise from children around the school echoes up the concrete stairwell and corridors.

>> Access to open/green space

Situated within a particularly urban site, the few green spaces within walking distance are private. Bureaucratic barriers mean that currently children do not go out of school for exercise, as the permissions required are difficult and lengthy to obtain from the MCGM because of the route via a main road.

>> Proximity to Canal

The Lovegrove canal is currently unsanitary and used as a dumping site for all sorts of waste mainly by local inhabitants, who are not provided with regular municipal waste collection; brightly coloured piles of fabric cuttings can be seen along the canal edge where tailors discard them. Settlement dwellers rely mainly on the informal but essential ‘rag-picker’11 trade for waste management, sorting and disposal. The canal is in close proximity to both Mariamma Nagar and Lovegrove School and a breeding ground for mosquitos.
Above: View of Mariamma Nagar from Lovegrove School classroom window.
Below: View of Atria Mall from Annie Besant Road.

Above: A mother and Lovegrove pupil walk home after school.
Below: Motorcycles and cars are parked all around the residential and school buildings.
Above: Lovegrove Muktangan first floor corridor, used by 1st to 5th standard classes.
Below: Lovegrove Marathi medium third floor corridor, and pupils on their way to their next class.

Above: Painting in the Lovegrove stairwell.
Below: Lovegrove Marathi medium classroom.
Mariamma Nagar

>>Settlement location

Mariamma Nagar (Mariamma ‘place’) is located opposite the school and sits between two branches of the Lovegrove Canal, in an area of approximately 24sqKm. It is centrally located with the Mahalaxmi racecourse and the Nehru Science centre as neighbours, quiet and surrounded on two sides by trees. A new bridge leading to the settlement is under construction and soon to be finished, which will cross the canal to Annie Besant road, Mumbai’s main western north-south artery. Currently there is no vehicular access to the settlement, accessible only to two-wheelers, and the inhabitants are excited at the prospect of better access. Mariamma is part of a larger settlement network that is referred to as Jeejamata Nagar. The settlement comprises a large proportion of residential dwellings, unlike Dharavi which is famous for its huge industrial, recycling and retail sectors, although you can find tucked away many small traders and workshops such as tailors, bag-makers, bakeries and mechanics.

>>Settlement history

Mariamma Nagar sprung up when 300 inhabitants from informal settlements the city were relocated in 1982. Relocation was then and is now in most part due to site clearing for development of either private construction or SRA (Slum Rehabilitation Authority) projects: Residents are re-located temporarily until the new building is ready, at which point they (in theory) return to new flats. The number of inhabitants grew to around 15000, but 6 years ago relocation and site clearing meant that inhabitants were moved to other settlements nearby such as Worli Naka, Lower Parel, Parel, Bandra and Mahim, reducing the number to around 5000.

>>Settlement people

At first glance the settlement resembles an ad hoc collage of hutments. But upon closer inspection, many homes have been carefully built, with custom made balustrades and ladders, decorated with plants and newly painted facades, and others more rudimentary. At the main entrance there are some remnants of demolished homes, many animals (goats, dogs, cats and cockerels), children playing and people going about their business. Further exploration quickly reveals that Mariamma has all the ingredients of a self-sufficient village and a relaxed community ambiance. Men sit together in the shady alleyways playing games, and women wash clothes outside their homes. A main street runs through the centre of the settlement, with shops such as a barber’s, doctor’s surgery, grocer’s, tailor’s, bakery, butcher’s and many hawkers selling produce (spices, grains, vegetables, paneer cheese, masala and chai) from carts or buckets.
New public bridge currently under construction, is seen as a positive development by the community and will serve as road access to Mariamma Nagar.

Hutments were demolished here 2 years ago in order to bring building materials to the construction site. Residents were re-located to Virar, a far northern suburb.

Construction site: A new pumping station is being built, with an access bridge from Atria Mall.

Mariamma’s main street: Vegetables, chai, bread, grains and pulses, chicken, paan etc... can be bought from permanent shops or cart vendors here.

Jijamata Nagar a larger adjacent informal settlement, reachable by foot from Mariamma Nagar.

Happy Home and School for the Blind

Route to school from Mariamma Nagar

Nehru Planetarium

Lovegrove School, and surrounding BMC residential buildings

Existing pedestrian bridge, home to a street barber and a shrine

Mariamma Nagar Mandir Settlement Temple

Existing pumping station

Lovegrove School, and surrounding BMC residential buildings

Construction site: A new pumping station is being built, with an access bridge from Atria Mall.

Hutments were demolished here 2 years ago in order to bring building materials to the construction site. Residents were re-located to Virar, a far northern suburb.

Jijamata Nagar a larger adjacent informal settlement, reachable by foot from Mariamma Nagar.

New residential building under construction: Building will be for Mariamma Nagar residents once finished. However construction work has stopped. Residents were re-located to make space for construction and there are issues with the developer.

Doctor’s surgery: The doctor is also responsible for collecting money for water and electricity bills and is a community leader.

Committee premises: Members are the first port of call to newcomers and are in charge of dealing with community issues.

Lovegrove School, and surrounding BMC residential buildings

Construction site: A new pumping station is being built, with an access bridge from Atria Mall.

Hutments were demolished here 2 years ago in order to bring building materials to the construction site. Residents were re-located to Virar, a far northern suburb.

Jijamata Nagar a larger adjacent informal settlement, reachable by foot from Mariamma Nagar.

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Doctor’s surgery: The doctor is also responsible for collecting money for water and electricity bills and is a community leader.

Committee premises: Members are the first port of call to newcomers and are in charge of dealing with community issues.
Also located on the high street are the premises of two committees, that look after local political/decision making business: Mariamma Nagar Welfare Society and Mariamma Nagar Vikas Sanmanye Prathistan. I met with the latter to find out more about life in the settlement.

**Settlement buildings**

The settlement is mainly made up of hutments, built from a variety of materials such as brick and render, corrugated iron, welded steel, timber, bamboo and coir rope, plastic sheeting and other found/reused items. Local hutment contractors provide labour to build dwellings and take care of subsequent repairs and maintenance. On the ground along pathways, water pipes are slightly recessed into concrete slabs dotted with services access covers, to bring water to some homes and some communal water-points/WC’s.

A new residential building is being built on the east side of the settlement by developer Akshay Stapate Private ltd. as part of an SRA project. When I visited the settlement committees, a discrepancy in building area provision had been under delivered and had led to a four year pause on site; this illustrates how settlement dwellers have little power up against developers and builders.

‘Transit camp’ buildings exist in most settlements in the city, built as temporary residential provision for families before they are moved to SRA projects or relocated. Residents complain of lack of space and light especially in comparison to their previous dwellings in hutments of one or two storeys, which they often prefer. These buildings tend to outlive intended timeframes, due to disputes and delays and lack of alternative housing.

**Resources, health and sanitation**

Within the settlement, water is provided for 3 hours each morning at communal tap areas. Residents I spoke with found it unsatisfactory, and specified that water was not potable and of poor quality. Shared WC’s are provided in small purpose built buildings, which are infrequently-cleaned: Cleaning should be carried out by BMC contracted firms, therefore presenting a similar situation to that of Lovegrove school.

I visited the local Doctor, Dr. G.P. Varma who has been working in Mariamma Nagar since 1992. His role goes beyond medical care: Not only is he a trusted community leader but he also organises payment of utility bills for all residents (only 20% pay bills at all) and his surgery is a community hub. Anganwadis, who are part of the Integrated Child Development Service, are kindergarten teachers responsible for children’s health and nutrition: They can be found working all over the settlement and indeed most settlements in the city. In majority they are women paid and employed by the government (and sometimes Unicef) to supplement young children’s diets with nutritious food at lunch time, many of whom have very low HB levels. However the quality and variety of nutritious food is questionable, consisting either of rice, daal (lentils) or a subzi.
(vegetable dish), biscuits and apples.

The anganwadis are also local pillars of the community: The women who number approximately 1 to 1000 inhabitants. are trusted by families and children and doing much needed work to help with medical and counselling needs.

For further medical services the people of Mariamma Nagar mainly travel to Jeejamata Nagar over the bridge by foot, to the nearest Health post and Dispensary.

Below: Mariamma Nagar community pillars: Anganwadis, Doctor Varma Panchigani (left) and Shrinati Sukheta Jagal (Centre left).
View of Doctor’s surgery located on Mariamma Nagar’s main street.

Example of a settlement alley with home entrances on either side.
Local barber’s located on the path between Jeejamata Nagar and Mariamma Nagar.

A paneer-wala in an alley in Mariamma Nagar.
Chapter Two: A learning architecture: Workshops, prototypes and critical pedagogy

>> Themes of study

During preparatory research I had many conversations with teachers and school staff: It became apparent that Lovegrove School faces environmental difficulties that make it hard for teachers and pupils to carry out activities that require concentration. This study mainly focuses on the effect external factors have on concentration, including noise, air quality and nutrition.

Research into the effect of an environment on learning outcomes is gaining momentum, and recently a study by Nightingale Associates together with the University of Salford showed that pupils’ academic progress could be affected by as much as 25% over the course of a year due to classroom environment.

During the study we developed an active, participatory and reciprocal learning process in and from the city; ultimately design responses would need to be condensed, temporary and simplified in order to demonstrate easily replicable and affordable solutions.

At Lovegrove School, I worked with a class of ten year olds, in fifth standard: We started by exploring the theme ‘noise’, followed by ‘air-quality’ and ended with ‘nutrition’, carrying out regular design sessions during Muktangan ‘Work Experience’ classes, with the aim of engaging the children from the initial conceptual design through to the critical development of each prototype.

>> Design strategy and hopes for the project

Here, the Architect has a role of activator and facilitator with the aim to produce a sustainable strategy, developing a process but also responding with a built object. These objects are not final, but aim to be used as a continued means of learning both for the school community and for the Architect. In this sense it is a reciprocal learning practice.

Mumbai is peopled with small businesses carrying out traditional crafts with natural materials. Materials appear to have certain stigmas attached to them, for instance the temporality of a biodegradable material maybe reduces it’s value. Regardless, as far as possible in this project we aimed to use ‘sustainable’ materials such as woven bamboo or even recycled cartons.

It was important that prototype designs would ultimately transfer smoothly to similar situations, that fabrication and insertion was fast and easy in order that they be considered by the wider network of schools, and that they wouldn’t create extra work for staff. The exploration of a local heritage of design languages aimed to create mirrors of the city through the prototypes, from local crafts-people who bring precise urban identities through materiality and tradition.

Above: Bandra cane weaver at work on a stool at their workshop.
Successful prototypes aimed to respond to the environmental themes in a positive manner, helping create more comfortable learning environments. In a more abstract sense, I hoped the prototypes would become drivers of communication and negotiation between the school children and staff, the NGO, the children's families, the municipality and finally the government.

1. The noisy city

>>External noise in relation to cognition

Mumbai is a particularly noisy city, a prominent environmental factor that to an extent many of its inhabitants have adapted to. There is however a vast amount of research that shows some types of noise can be unhealthy, sometimes with physical and psychological effects on those who are subject to severe exposure, particularly that of road traffic.

In the urban school environment unwanted external noise is a common issue. Many municipal schools are located on busy roads, but must keep windows open to let through a cooling breeze, especially when in the summer temperatures can rise up to over 40 degrees Celsius. Indeed a UK based study by Shield and Dockrell from the Institute of Education demonstrates that some external noise has a negative effect on pupils' concentration:

'External noise was found to have a significant negative impact upon performance, the effect being greater for the older children. The analysis suggested that children are particularly affected by the noise of individual external events. Test scores were also affected by internal classroom noise, background levels being significantly related to test results.'

_The effects of environmental and classroom noise on the academic attainments of primary school children, Shield and Dockrell, 2007_
In relation to the thematic ‘noise’ we held two workshops exploring with our fifth standard class how some sounds could form noise ‘pollution’ and how they could affect concentration. We began by brainstorming the concept of ‘noise’ and explored distraction levels relating to certain types of sound, when children were trying to work at school or at home. We held experiments in the classroom in which children carried out maths, reading and writing exercises to various local noises. The pupils decided that certain sounds were more distracting than others: For instance traffic and car horns were most distracting, along with the sound of a wedding band and dogs barking, but the sound of rain falling on a roof, less so.

We then continued with acoustic tests, using natural local materials such as jute, woven cotton, woven bamboo and loose coir to dampen sounds: Cotton cellulose and jute dampened direct sounds most effectively. We chose these materials due to their tested acoustic properties, particularly described in a study by the University of Perugia as being effective sustainable new materials for noise control17.

To conclude the sound-related design sessions, children made models to communicate imaginary places in which they could concentrate better, taking into consideration provenance of sounds located inside or outside, and how they might use the materials we had tested together in their designs.

Pupils took home sound journals, which they would complete during homework time; they would log sounds heard whilst working, and describe the degree to which they were distracting.

Using the information gathered and inspired by class designs, we defined three focal points: To reduce sounds entering school windows from outside, to dampen sounds in the same room, and to design a means to do homework inside or outside the home.
**Prototypes**

- **Window-box**

Sounds from the shared compound bounce up onto the concrete window ledges and into the classrooms. In collaboration with Harriet McKerrow from the Arup Mumbai office we designed a window-box that would aim to dampen sound on its way into the room, as it travels in a straight line from its source. The design concept was inspired by a passive ventilation product ‘Passivent’ which is installed in classrooms as a permanent clerestorey aperture: Sounds are absorbed on their way through by a thick layer of foam. With an aim to capture sound with natural sustainable materials, we chose to use woven bamboo.

Opposite Mahim station, not far from Dharavi, on pavements either side of the main road can be found rows of bamboo weavers and their families. This informal but well-known centre of craftsmanship is an invaluable city industry, supplying all types of trades with useful containers and products. The pavements are also home to the families, who have in many cases lived there for decades.

I started working with a particular couple, to develop many of the prototype designs and material tests. Originally from the north of Maharashtra, on the border of Gujarat, they are both from families of weavers, from whom the craft had been passed down for generations.

The ‘window-box’ design began as a solid-framed insert and then became a flat foldable/portable object: It comprises four sides of woven bamboo with hinges at each corner and jute ribbon edging. In addition to its sound dampening properties, the prototype also softened the aspect of the window reveal, adding a natural material to the classroom surroundings. In order to improve the product, future developments could include thickening each side with an infill of loose coir, to absorb more sound as it hits the surface.

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*Above left: Initial sketch for window-box prototype; Above right, Pupils ideas for what the window-box could do. Below: Section diagram showing location of window box and its dampening effect on sounds coming from the courtyard below.*
- Quiet head-rest
This prototype aimed to respond to the idea that the class wanted to be able to sit either at home, or in the classroom whilst being able to read quietly. This intervention was inspired by one of the pupils imaginary models of a small, quiet and private space within the home environment. During the previous material explorations, we found that cotton (cellulose) was one of the best acoustic insulators.

The design had to be small enough to fit inside either a home or classroom and to be transportable. On Bazaar Street, we found a local Gadda-wala (mattress maker) to fabricate a cotton filled cushion that would provide a soft pillow and dampen noise. To compare, he also made a Coir (coconut husk fibre) pillow, that was neither as acoustically effective nor as comfortable.

Cane furniture is very popular in Mumbai, and around India. It’s relatively cheap (in comparison with timber), suited to the climate and versatile, and cane weaving workshops can be found all around the city. In the northern suburb Bandra, I found a shop run by two brothers, a very different working environment to that of the family in Mahim. Cane is more hardwearing than bamboo, but also more expensive. The Cane weavers fabricated a head-rest, weaving around a single curved piece of cane, designed to be hung on the wall of a home or classroom, and protect the ears and sides of the head from distracting sounds.

- Portable desk
Responding to the need to work in different locations, whether at school, at home or outside, we proposed to design a portable desk. Both cane and bamboo weavers each made samples; we tested two types of cushion, one filled with coir and the other cotton. A local bag-maker located in Mariamma Nagar fitted pockets and straps to the cushions, turning them in to back packs. Again however, pupils preferred the cotton prototype.
Above: Mahim bamboo weavers: Jagdish and his wife at their workshop.
Below: First window-box prototype test.

Above: Bandra Bazaar road gadda-wala finishing a cotton filled mattress.
Below: Mariamma Nagar bag-maker fitting straps to the portable-desk.
2. Fresh air and concentration

>> Air-quality and its relation to concentration

In Mumbai, the recent increase in personal car use has led to an over-loaded road network, with no comfortable transport alternative for city dwellers: The trains are full to bursting at rush hour, footpaths are often obstructed and difficult to walk along, and it is dangerous to cycle. Traffic jams are a daily occurrence for car users in the city. In addition to the increase of car fumes in city air, there is also a high number of buildings being demolished and new buildings being put up, leading to a rise in airborne dust particles, in addition to an increase in CO2 levels.

In Mariamma Nagar, a common way to dispose of waste is to burn it: Piles of rubber, plastics, textiles and papers are routinely burnt in the settlement by/in the canal. The smoke adds to the air pollution, and the dust and machinery smoke from the nearby new pumping station and residential block construction site; On top of this, Atria Mall waste disposal area is adjacent to the school, the smell of which permeates daily, in addition to that of the school’s own drainage system.

Many office buildings nearby have similar surroundings; but they can keep windows closed thanks to provision of air-conditioning units, that reduce noise and dust from outside. However municipal schools lack these types of resources, and in most cases there is nothing to filter the air.

Research into the subject of air-quality relating to concentration has been widely carried out: In particular, a study by researchers at the University of Exeter found that low CO2 levels and poor ventilation inside classrooms led to a 5% decreased attention span in a class of primary school children17.

A cheap and effective way to clean the air is to use plants: NASA researchers compiled a list of plants as part of the ‘NASA Clean Air Study’18 that naturally filter the air we breathe, whilst removing harmful chemicals such as formaldehyde, toluene, xylene, benzene and ammonia. It is based on this research that the idea for a fresh-air desk for Lovegrove School came about.

>> Fresh-air desk workshops

Following an initial investigation into ‘pollution’ as a theme, together we broadly studied plants’ air-cleaning properties, and how they might help in the classroom. During the introductory session each pupil chose a plant that they would look after for two weeks, from a selection of Spider plants, Dieffenbachias and Indian money plants, with particularly strong air-filtering properties and hardiness. In a subsequent session, pupils designed their own fresh-air desk. Based on their ideas, we put together a sketch proposal and fabricated a prototype for the classroom.
RUR (R U reducing, reusing, recycling?) is a local organisation that works on developing processes and sharing knowledge of waste management in the city. At a Prabhadevi based supermarket Sahakari Bhandar, shoppers bring used empty Tetrapak cartons to be collected at the shop exit; at the recycling plant just outside the city, cartons are separated into cardboard on the one hand and aluminium and plastic on the other. The cardboard component is separated for paper products and the aluminium/plastic mix is heat-pressed to make a board. Some of the plastic is used to make a waterproof corrugated sheet often used as a roofing material. RUR also run programmes with schools around the city, where they set up collection points, and provide the schools with new desks in return.

Using this material meant integrating an active learning exercise about recycling into the project, and testing a new material that is fabricated nearby; we also chose to use RUR’s manufacturers Haycon Industries, located in Navi Mumbai. They already had stock of the materials and the experience necessary to build a safe and child-friendly desk. In this instance, we chose not to use a local metal worker or carpenter, because we required a particularly easy to reproduce, safe and durable product. This prototype explored the use of a more industrialised fabrication process, whilst trying to use locally collected recycled materials.

>> Critical design session

We held a ‘critical thinking’ session for pupils to give feedback on the finished product, how it could be improved and why. They proposed some amendments to the design: A smoother writing surface, for it to be lighter, to include more plants, to have wheels, to incorporate a tray under the plants that was removable to collect excess water, and to re-design them to be more easily stackable.
Above left: Fresh-Air desk drawing by Arshal A Kahan, fifth standard. Above right: Fresh-air desk with inset money plant. Below: Recycled Tetrapak workshop with fifth standard, showing an example of home-made paper.

Above: Shredded Tetrapak carton before separation of paper from aluminium and plastic. Below: Fresh-air desk analysis workshop.
3. Nutrition and learning

Mal-nutrition in very young children has been proven to have detrimental effects on health, growth and motor/cognitive development. In primary children it can result in behavioural problems and deficient social skills, decreased attention, deficient learning and lower educational achievement. Muktangan School actively engages in enhancing children's nutrition by providing fruit twice a day to all of its pupils and staff, and are eager to do more to tackle the problem, particularly at Lovegrove School.

>>An edible playground

The aim of this third project was to involve the children in designing and building their own garden, which ultimately would provide them with fruit and vegetables to eat at school, and a space within which to play, run around and be outside. In Mariamma Nagar there is little private space to grow fruits and vegetables, and a lack of light in the dark alleys between hutments. Parents I spoke to were wary of letting their children play far from home in the settlement, and were worried about the dirt and dangers around.

In order to define a brief for the garden, first I met with Lovegrove teachers, to develop the idea of building a playground/garden at the school. After a short site analysis, we outlined two areas as potential garden locations. The school decided to make a trial garden to the front of the building, as a test to see if the plants survived, how much watering they would need and if they would get damaged or stolen.

This part of the school has a large footfall; parents wait outside the lobby for their children at pick-up time, and when the school is closed, resident children play ball-games in the area. Because the school property is owned by the BMC, and Muktangan is a tenant, the relationship between them is delicate and there is already some tension between schools: For this reason the school required a temporary garden design.

Following a workshop with teachers, we met with parents and their children, splitting into groups, each developing their own design for the garden. Parents unanimously proposed a sheltered place where they could wait for their children. Children unanimously called for a space to play and sit outside: Both parents and children wanted a garden.

In collaboration with organisation Fresh & Local, we built the prototype garden, planting fruit trees, herbs and flowers in woven bamboo baskets lined with geotextile. We used permaculture techniques we had tried and tested at Flyover Farm. We filled the baskets with dried leaves, coconuts and soil, and finished just in time to escape the rain, as monsoon had begun early.
Conclusion

>>Obstacles & Limitations

None of the limitations and obstacles we faced meant that the projects were impossible, however many did result in delays. For instance, I had not accounted enough time for some festivals, and many times of year when manufacturers would be absent for weeks at a time. Holi (festival of colour held in mid-march) is a national holiday, when many city dwellers return to their villages for at least two weeks. Again in May when the city is swelteringly hot before monsoon, those who can, leave for cooler climbs. Delays however are a common problem in India, and extra time therefore must be generously factored in to any programme.

I worked on quality control with manufacturers in some detail, relating to the safety of products and their appropriateness for children, removing sharp edges and implementing safety fixings. Initially I communicated designs using sketches showing dimensions, but quickly realised that models or maquettes would be a more appropriate. In addition, I had spent a year learning Hindi which was an essential tool that gave me independance and ability to discuss design developments with crafts-people.

The delicate relationship Muktangan has with the BMC also meant that the garden prototype was less ambitious than anticipated. In addition, some of the noise prototypes have not been re-installed after the Summer holiday. We faced some issues during the garden build relating to drainage, large puddles forming outside the school entrance. This we overcame by laying a plastic grid to raise the baskets from the ground, with a view to placing planters on bricks in the future. The rear site is currently unhygienic: Rubbish gathers and this attracts pests. This area requires refurbishment before a garden can be built, with new paving to be laid, drain covers checked and replaced for safety.

>>Successes and points to take forward

Some of the most successful elements of the project have been to do with participation of staff, children and parents, and the positive outcomes and feedback they have given with regards their involvement. Children particularly enjoyed developing critical thinking and gaining empowerment to change their environment.

The development of connections with other organisations, some new and some existing has helped widen networks, learn new techniques, and create new relationships; RUR and Fresh & Local will continue working with the school in the future on sustainable city related projects.

Material tests and experiments were particularly interesting and successful; however there is
Above: Edible garden workshop at Lovegrove school.

Below: Bamboo baskets are lined with filter sheet, coconuts, dried leaves and soil, before planting Mango, Chickoo and Starfruit tree.
further research to be done in respect to all of the themes and prototypes. The portable desk is being used by pupils, however the quiet head-rest requires design amendments before it could be integrated into a classroom or a home. The acoustic window-box and fresh-air desk were most successful in terms of practicality and ease of use, and therefore we intend to develop them further next year, and include a more empirical study of their environmental effects. Following further research, we aim to demonstrate to the BMC and other governing bodies the value of actively designed interventions, and the pedagogical processes that have been developed to enable their fabrication as well as the value of the prototypes themselves.

The relationships I built with craftsmen and industries over the past year went from strength to strength and are some that will continue through the longer-term research project. To continue the project, we will explore learning in the home environment, developing through a critical pedagogical mapping exercise the basis for new designs, and catalyse the production of a new family of learning interventions in the settlement.

To build a trusting relationship with the committee members and residents of Mariamma Nagar is an essential foundation to the project’s further success. Building further stakeholder relationships is also an essential ingredient for the project to continue.

Following the edible-garden prototype assessment, and the preparation of a new ground surface between the school building and the canal, we propose to build a garden to the rear of the school, developing some of the themes already outlined in this report. We hope to build more pupil-led prototypes in the school and in Mariamma Nagar, resulting in method manuals for each of the partners, with built, tested and improved interventions as demonstrations.

As a result of the last year’s work between the school and the settlement focusing on healthy environments, and through the participatory design and build of these interventions, I believe there is an important and more wide reaching role for schools to play within the communities they serve, that can be provided for architecturally. Although some of the prototypes successes are hard to measure, the interventions developed over the past year are just the beginning of an in depth proposal to explore how schools can be improved cheaply, sustainably and inventively.

It is through exploring the complex links between governments, organisations, communities and individuals, within contexts that are at times at odds that we will be able to develop appropriate strategies and then designs.

These design experiments are a means of defining experimental strategies through exploratory spatial practices, using interactive methods within a particular community and a local culture. They could then, be applied anywhere. It is this methodology that will be detailed and recorded relative to each participating group as part of my continuing PhD in Architectural Design at The Bartlett, UCL, between the Development Planning Unit and the School of Architecture.

Mayalu (creeping spinach)
Layers of dried leaves
Layers of soil
Empty green coconuts filled with dried leaves
Filter sheet as an anti-pest and way to keep nutrients in
Plastic perforated drainage sheet

Above: Sectional diagram showing permaculture techniques used in edible garden.
Below: Sketch for proposed plan for Lovegrove outside space.
Footnotes


2. 2009 Right to Education Act is a piece of Indian legislation that describes the importance of free and compulsory education for all children between the ages of 6 and 14, and that subsequently became every child’s fundamental right as part of the Indian Constitution in 2010.


4. Marathi is the local language spoken in the Indian state of Maharashtra, of which Mumbai is the capital.

5. A ‘chawl’ building (derived from the Marathi word chal) is a type of tenement building found all over Mumbai, usually built in the early 20th century to house workers, particularly in the cotton trade. Worli and Lower-Parel areas were home to many textile mills, hence the great number of chawl buildings found there.

6. Constructivist pedagogy: ‘Rather than behaviors or skills as the goal of instruction, cognitive development and deep understanding are the foci; rather than stages being the result of maturation, they are understood as constructions of active learner reorganization. Rather than viewing learning as a linear process, it is understood to be complex and fundamentally non-linear in nature. Constructivism, as a psychological theory, stems from the burgeoning field of cognitive science, particularly the later work of Jean Piaget just prior to his death in 1980, the socio-historical work of Lev Vygotsky and his followers, and the work of Jerome Bruner, Howard Gardner, and Nelson Goodman, among others who have studied the role of representation in learning.’ Catherine Twomey Fosnot and Randall Stewart Perry, *Constructivism: Theory, perspectives and practice*, 2004.

7. Montessori is an early childhood educational approach, developed in the early 20th century by Maria Montessori, to provide children with a pedagogy and environment in which they can learn freely and actively, with a range of potential choices and in a mixed age class.

8. Steiner education, otherwise know as Waldorf education, was developed and founded by the Austrian philosopher Rudolf Steiner as a humanistic pedagogical approach, to encourage children to learn through active creative play.

9. Reggio Emilia is both the name of the city in northern Italy and that of the educational approach developed there by Loris Malaguzzi after the second world war. Reggio Emilia is a child centric approach that gives importance to citizenship and parent’s inclusion in education, most importantly using the environment as a ‘third teacher’.

10. BMC - Brihanmumbai Municipal Corporation is also known as the MCGM - Municipal Corporation of Greater Mumbai, and is the governing body for the city.

11. ‘Rag Picker’ is the term used for the people who sort Mumbai’s waste, separating out metal, from plastic, cardboard and paper, which they can then be re-sell by weight.

12. Dharavi was India’s largest informal settlement, located in what is now considered a central part of Mumbai. Today however there are four larger settlements in the city alone.

13. SRA - Slum Rehabilitation Authority in Mumbai organises the development of residential buildings to replace ‘slum-dwellers’ hutment accommodation with the aim to clear Mumbai of informal settlements and provide formal housing. See www.sra.gov.in for more information.

14. ICDS - Integrated Child Development Service ‘aims at providing services to pre-school children in an integrated manner so as to ensure proper growth and development of children in rural, tribal and slum areas’ from www.icds.gov.in

15. Study by Nightingale Associates and University of Salford - ‘A holistic, multi-level analysis identifying the impact of classroom design on pupils’ learning’ by Peter Barrett, Yufan Zhang, Joanne Moffat and Khairy Kobbacy, 2012.

16. The study ‘Survey On The Acoustical Properties Of New Sustainable Materials For Noise Control’ by Francesco Asdrubaliwas from University of Perugia was presented at Euronoise 2006, Finland.


18. The Nasa ‘clean air study’ led to the publication *How to grow fresh air: 50 houseplants that purify your home or office* by Dr. B.C. Wolverton, 1996.

19. RUR - R U Reducing, Reusing and Recycling? is a Mumbai based organisation that promotes recycling and reducing waste to the city inhabitants by running workshops. See www.facebook.com/RUR.AreyouReducingReusingRecycling for more information.


22. Permaculture, or ‘permanent agriculture’ is a type of ecological design aiming to maximise yield and minimise work to create sustainable (food growing) environments inspired by ecosystems. See www.permaculture.org for more information.

23. Flyover farm is a collaborative project between Mumbai based organisation Fresh & Local and Nicola Antaki to design and build a community roof-top farm in a dense and urban area in south Mumbai, Mohammed Ali Road. See www.freshandlocal.org for more information.
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For more information on 'A learning architecture' please visit www.nicolaantaki.co.uk