The hole in the wall

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1969: My friend, Gora, takes me to the Odeon in Delhi to see Arthur Clarke and Stanley Kubrick’s “2001, a space odyssey”. A black monolith is found in Africa. Another on the Moon. The monoliths seem to do nothing at all. All humanity is desperate to learn more about them. We love puzzles.

1987: I have a PC with a ten Megabyte drive. I spent Rs. 50,000 (about £800 at that time) to buy it, nearly a year’s salary. My son is six and I need to protect my PC from him. He agrees not to touch it. But can he watch? Sure, I say. Let’s see what sense he makes of DOS commands.

A month later, I have lost a spreadsheet file. I search directory after directory scrolling up and down the file lists. A small voice from the back says, “If you do dir/w all the files will show side by side as well”. I gulp. “Really?”, I say, “Well, you can try it yourself, just be very careful”. 

Two months later he is playing Moonbugs, Simcity and Flight Simulator. Six months later, he does things with DOS that I never thought were possible. He types faster than me.

1988: I write a paper for the annual conference of the All India Association for Educational Technology. It says maybe we should just give PC’s to small children and leave them alone to figure it out by themselves. Surely, some smart kids will learn to use it by themselves. Let the best get better, the rest can follow later, says the last part of the paper. The delegates think it’s a fascist, preposterous idea.

1999, January 26. My friend, Vivek, built a computer sunk into a wall near my office at that time, in Kalkaji, New Delhi. The screen was visible from the other side of the wall. A touch pad was built into the wall as well. Children came running out of the nearest slum and were at the wall, as though pasted with glue. A few hours later, a visibly surprised Vivek said the children were surfing.
A few days later, the media arrived and this little experiment got the entire world’s attention. I think every newspaper and every TV channel on earth has reported what the media called “The Hole In The Wall”.

But how does this magical computer literacy happen? It took five years, a lot of travel and a lot of money to find out. There were great surprises and great disappointments on the way. But, in the end, Nature’s lessons were simple, direct, and, in retrospect, obvious.

After the heady rush of the Kalkaji experiment, it was time for some scientific introspection. Within six months, the children of the neighbourhood had learned all the mouse operations, could open and close programs, surf the Internet and download games, music and video. When asked they said they had taught themselves. They were describing the computer in their own terms, often coining words to describe what they saw on screen. The hourglass symbol was “damru” (Shiva’s drum), the mouse cursor, “sui” (needle) or “teer” (arrow).

We repeated the experiment twice, once in the city of Shivpuri in Madhya Pradesh (Mr. Digvijay Singh, the then Chief Minister, was interested) and once more in a village called Madantusi in Uttar Pradesh. The Madantusi experiment was the first time we got external funding. Dr. Urvashi Sahni, principal of a school in Lucknow and a keen educationist, raised the money from her friends in the USA.

Both experiments showed the same results as in Kalkaji. The children seemed to learn to use the computer without any assistance. Language did not seem to matter. Neither did education. Had we stumbled on to something universal about children and computers? I needed research funding, desperately.
The funding came in quite on its own! The ICICI bank’s Social Initiatives department wanted 10 computers to be put in villages in the Sindhudurg area of Maharashtra. The idea was driven by a young banker called Bikram Duggal, to whom I and thousands of rural children should be grateful.

Mrs. Sheila Dixit, the chief minister of Delhi, visited Kalkaji and the then Principal Secretary, Mr. Regunathan, a long-time educationist, took what he called a calculated risk. He funded 30 computers in the Ambedkar Nagar area of Delhi. Today, more than six thousand children need to thank him for that decision.

And finally, James Wolfensohn, then president of the World Bank, came to Kalkaji. He had heard of the experiment from Peter Woicke, Director of the International Finance Corporation. Together, they decided to fund a three year research project to find out if what had happened at Kalkaji was a freak accident or a universal learning mechanism. That decision would affect the futures of 40,000 children to begin with and, maybe, all the children in the world one day.

India is a good laboratory for finding out if any child in the world would respond the same way to a hole in the wall computer. We have all the diversity of children that the world has. Economic, social, genetic, cultural, physical. You name it, we have it.

India is also a good laboratory for finding out if computers can survive outdoors, built into walls and buildings. We have all the weather conditions the world has.

The research design was simple. We would install computers in 22 locations across India, chosen for their diversity of human and climatic conditions. We would then choose 15 random children as a focus group and measure their progress over 9 months. We would then compare them with other children who do not have exposure to computers and see if we can get to an explanation for the “hole in the wall” effect.

First, we needed some tools to measure with. How does one measure computer literacy? We found tests on the Internet that took hours to administer. Too long for our purpose. As the funding clock was ticking, we had to find a solution fast.

Desperation can often do wonders in science. In this case, it produced an Idea.

Two scientists from our centre, Parimala and Ritu proposed a test where you are shown the 77 common icons in the Windows environment. You are then asked to describe what they may be for. If your description is correct you get a mark.

It seemed like a simple but stupid test. We all use computers quite well, but do we know all the icons? Of course not, some of us don’t use the icons at all.

Pari and Ritu did not listen. They administered it to all our office people. The results were interesting, we got around 70% of the icons right, irrespective of whether we use icons or not. Not only that, the people who do a lot of spreadsheets got the Excel icons right, the
ones who do a lot of word processing got the Word icons right. It seemed as though familiarity with an application gives you the ability to guess the icons of that application correctly, even if you had never used them.

Another colleague of mine, Monica, and I did a validation of Pari and Ritu’s Icon Association Inventory (the official name for the icon test). We gave two sample groups the icon test and also a much longer American test of computing literacy. The results matched to an incredible 98% correlation. The icon test would measure, in twenty minutes, what the other test would in two hours. We had our measuring instrument. Ritu added a battery of intelligence and creativity tests to the icon test, our basic measurement.

While we were sharpening our measuring instruments, Ravi Bisht, the creator of India’s first shopping catalogue applications among many others, was traveling from village to village all across the subcontinent. Wherever he found an appropriate place and a friendly panchayat or school, he built a little structure with three computers facing the road. His design is today the standard design for the hole in the wall.

A “hole-in-the-wall” kiosk in Takeo, Cambodia, 2004

Sanjay Gupta, head of our centre, had another set of problems to solve. Touchpads would fail within weeks of installation outdoors. Key tops would vanish. Power conditioning would cost more than the computers. The dust would get into everything.

In the years between 1999 and 2002, Sanjay and Ravi made a series of inventions and solved all these problems. They invented new mice, keyboard covers, reversed exhaust
fans and thousand other vital little things. They made it possible for ordinary PC’s to work outdoors. Anywhere.

View of a kiosk showing the child friendly design

If a computer went into a hang in a remote village in Kanyakumari, would someone have to fly from Delhi, just to press the reset button? We wrote software that would enable us to “see” our computers from anywhere through the Internet. We wrote software to prevent Windows from hanging. We wrote software to protect our desktops from getting accidentally deleted.

And now, we were ready.

In 26 locations, with 100 computers standing in remote villages, our field observers began testing. Focus groups were tested for nine months and the results compared with control groups and other frequent users. An estimated 40,000 children use these computers. They have all made themselves computer literate. The average icon test scores stand at 40% in nine months. We have our proof of self-regulated learning. And this time we know that it will happen anywhere in the world, to any child, in any climate.
I decided to call this method, Minimally Invasive Education (MIE). The rest of the world continues to call it The Hole In The Wall. Alas.

In the meanwhile, the government of India gifted five kiosks to the government of Cambodia. These were the first ones we built outside the country. The Cambodian children were absolutely delighted. There were enormous crowds at every kiosk. The results – identical to those in India.

The library of Alexandria in Egypt wants to build 30 kiosks. We sent them kits and detailed instructions.

The CSIR of South Africa built two kiosks in villages of South Africa. The results were identical to those in India.

The French embassy in Delhi sent Pascal Monteil, a well known new media artist from Paris, to three of our villages with playground computers. Parimala went along with him to ensure that he did not “teach” anything. The children observed and questioned Pascal intently. Then, they taught themselves digital photography (using his camera!) and Photoshop in French! Then they started to draw. “This does not exist anywhere….except in your mind and the computer”, said Moumita, an unkempt little girl from Bishnupur, 24 Parganas, West Bengal.
Pascal took back over a hundred digital creations. He said in a lecture that his concept of how art should be taught has changed.

What did we find?

Groups of 6 to 13 year old children do not need to be “taught” how to use computers. They can learn by themselves. Their ability to do so seems to be independent of their:
1. Educational background
2. Literacy levels in the English language or any other language
3. Social or economic level
4. Ethnicity and place of origin, i.e., city, town or village
5. Gender
6. Genetic background
7. Geographic location
8. Intelligence

What do they learn?
An estimated 300 children can learn to do most or all of the following tasks in approximately three months, using the “hole-in-wall” arrangement with a single PC:
1. All windows operational functions, such as click, drag, open, close, resize, minimize, menus, navigation etc.
2. Draw and paint pictures on the computer
3. Load and save files
4. Play games
5. Run educational and other programs
6. Play music and video, view photos and pictures
7. Browse and surf the Internet, if a connection is available.
8. Set up e-mail accounts
9. Send and receive e-mail
10. Chat on the Internet
11. Do simple troubleshooting, for example, if the speakers are not working.
12. Download and play streaming media
13. Download games

In addition to the above task achievement, local teachers and field observers often note that the children demonstrate improvements in:

1. Enrolment, attendance and school examinations, particularly in subjects that deal with computing skills.
2. English vocabulary and usage.
3. Concentration, attention span and problem solving
4. Working together and self-regulation

Our measurements suggest the same.

If the hole in the wall is changing the children’s analytical skills, English and certain value systems, then its consequences are far greater than I could have imagined.

In the slums, local adults laugh, “If you take away their free time, petty crime and other naughty stuff will not happen”, they say. I am amazed. Never thought of it that way.

There is a frequently voiced concern about access to pornographic material through kiosks that are connected to the Internet. While this has happened once in a while, it is quite rare. In the last five years we have had less than 1.5% pornographic usage at any connected kiosk. This is because of several reasons.

First of all, our kiosks are meant for children below 15 years. That audience has only some marginal curiosity about pornography, that too among the upper age groups.

Second, our kiosks are in highly visible, public places. It is rather difficult for children to browse pornographic content when they are in heterogeneous groups and where the screen is visible to passing adults.

Third, our kiosks are monitored remotely and the screens are visible over the Internet. The children know this, as every kiosk has a sign announcing this.
The few instances of pornographic access that the remote monitoring system has recorded in the last four years have been due to access by adults. The reason why such access by adults is not common is because of an interesting design feature.

The kiosks are designed to be used by children. The screens are placed lower than the average adult’s height so that you would need to stoop to see them. A lid on top of the screen acts as a sunshade and that too tends make it difficult for taller people to crawl under it. There is a cowl on top of the keyboard and mouse that has a gap through which only small hands can go in. There is a seating rod that is placed such that an adult seating on it would not have enough legroom.

All this ensures that an adult needs to be in a rather peculiar position to use the kiosk. It is interesting that some adults have, nevertheless, not been thwarted in their attempts to misuse the kiosk. Fortunately, their numbers are small.

A very large number of children seem to benefit from the kiosks. In independent studies conducted at Madangir, New Delhi, three organizations concluded that 6000 out of a total of 9000 children in the area were now computer literate. This was achieved over three years through 20 effective computers in the hole in the wall configuration. This seems to indicate that up to 300 children can share one playground computer.

**How does it work?: The learning process in a minimally invasive environment**

Certain common observations from the experiments described above suggest the following learning process when children self-instruct each other in computer usage:

1. Sometimes, one child knows a little about computers already, he shows off his skills to others. Sometimes, one child explores randomly in the GUI (Graphical User Interface) environment, others watch until an accidental discovery is made. For example, when they find that the cursor changes to a hand shape at certain places on the screen.
2. Several children repeat the discovery for themselves by requesting the first child to let them do so.
3. While in step 2, one or more children make more accidental or incidental discoveries.
4. All the children repeat all the discoveries made and, in the process, make more discoveries and start to create a vocabulary to describe their experience.
5. The vocabulary encourages them to perceive generalisations (“when you click on a hand shaped cursor, it changes to the hourglass shape for a while and a new page comes up”).
6. They memorise entire procedures for doing something, for example, how to open a painting program and retrieve a saved picture. They teach each other shorter procedures for doing the same thing, whenever one of them finds a new, shorter,
procedure. They discuss, hold small conferences, and make their own timetables and research plans. It is important not to underestimate them.

7. The group divides itself into the “knows” and the “know nots”, much as they did into “haves” and “have nots” in the past. However, they realise that a child that knows will part with that knowledge in return for friendship and exchange as opposed to ownership of physical things where they could use force to get what they did not have.

8. A stage is reached when no further discoveries are made and the children occupy themselves with practising what they have already learned. At this point intervention is required to introduce a new “seed” discovery (“did you know that computers can play music? Here let me play a song for you”). Usually, a spiral of discoveries follow and another self instructional cycle begins.

In order for the above instructional objectives to be met, it is important that:

1. The computer should be in an outdoor, public, and safe location. Children, and often their parents, are apprehensive of enclosed spaces such as closed rooms or “clubs”. Locating computers indoors, even inside a school, is associated with regimentation, control, “studying”, pedophilia and other negatives associated with formal schooling. Locating a computer in a school playground, on the other hand, is ideal.

2. Children should use the computer in heterogeneous groups. Since the MIE process depends on exploration and discovery, working in groups is essential. Collaborative constructivism is the main paradigm of MIE. Children teach each other very effectively and are also effective at self-regulating the process. That is how over 100 children are able to use one computer.

3. There should be no adult intervention or supervision. Adults should not use the kiosk. All activity should be monitored remotely to ensure that the kiosk is being used for the right purpose.

4. PC functioning and Internet connectivity should be reliable.

Based on the experience and data gathered over the last four years, we feel that such “playground” access points should be a part of every primary school. Where primary schools are not available, such facilities could provide even more vital “emergency” educational inputs.

The government of India has installed such facilities in over 200 very remote locations in the Himalayas and the North East of the country. Over 100,000 children in these locations are now computer literate. The reason for putting “hole in the wall” facilities in such areas is an interesting one. The quality of education in primary schools seems to be related to their “remoteness”. The more remote a school is, the worse off it is. This is usually because the better teachers tend to migrate to the less remote areas. Ironically, teacher training does not solve this problem, but accentuates it. The better trained a teacher is the more the probability of his/her moving to a city or other urban centre. As a result, the quality of education in remote schools is less than that in the cities.
In this connection, it is important to point out that the terms “remote” and “migrate” do not, necessarily have to be in the context of physical, geographical distance. Schools in many areas of large cities, both in the developed and developing countries, show a decline in the quality of education in slums, ghettos and other disadvantaged areas of the city. It is reasonable to suppose that these schools like those in our rural areas, also have a teacher migration and motivation problem. We suggest that some areas of urban cities are socially, culturally and/or economically “remote” from other areas of the city. It is due to this kind of remoteness that teacher migration to less remote areas and the attendant decline in the quality of education, results.

Alternative methods that do not rely on teacher quality and motivation should be introduced into remote schools. Teacher-independent educational technology should be introduced into remote schools.

Usually, new educational technology is piloted in affluent, urban schools. Such schools already have good students and teachers. By piloting new technology in such environments we may conclude that technology is not useful to school education.

It is in remote areas, at the “bottom of the pyramid”, that alternative learning methods may improve the quality of education in schools that are remote from urban centres. The hole in the wall strongly supports that point of view.

Educational technology is usually not developed for that purpose. Most of the technology used in education today is borrowed from business, scientific, industrial and military technology. It is necessary to design and develop technology that can, to whatever extent possible, provide teacher-independent education in those areas where good teachers are not willing to go.

Educational technology should be designed for, and go first, into the remotest areas.

We could generalize the findings from these last eight years (1999-2007) work as follows:

1. Groups of children can self-regulate and self-organise their own learning, if given the appropriate resources.
2. While constructivism has been accepted as an effective educational method for a long time, we could re-define it with the statement, “Learning is a self organizing system”.
3. Collaborative learning from public computers is a process of acquisition – the learning is not imposed, hence the children accept it easily. Since value systems are also acquired and cannot be imposed (unlike doctrine or dogma, which are imposed and cannot be acquired), such collaborative digital environments are capable of altering the acquisition of values.
4. The quality of education is related inversely to the remoteness of schools.
Minimally Invasive Education through public internet kiosks for children should, no matter who or where they are, form an integral part of primary education in the 21st century. It has the potential to not only close the “digital divide” rapidly, but also to unlock the creative potential for self-development of children that eminent educationists have sought to do for over a century.

References:
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