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Self organising systems for mass computer literacy: Findings from the 'hole in the wall' experiments

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Abstract

Earlier work often referred to as the 'hole in the wall' experiments has shown that groups of children can learn to use public computers on their own. This paper presents the method and results of an experiment conducted to investigate whether such unsupervised group learning in shared public spaces is universal. The experiment was conducted with 'hole in the wall' (minimally invasive education, or MIE) kiosks in 23 locations in rural India. Focus groups in each location were tested for computer literacy for 9 months. Results, which are discussed in the paper, show that groups of children can learn to use computers and the Internet on their own, irrespective of who or where they are. The paper also discusses the engineering considerations for building such 'hole in the wall' computers in public spaces.

1. Introduction

The 'hole in the wall' refers to computers set up in public places such as streets and playgrounds for unsupervised use by children. In the rest of this paper, we will refer to such set-ups as "playground computers" (see figure 1). In earlier experiments, it has been reported that groups of children can

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self-instruct themselves to use computers and the Internet using such playground computers (Mitra and Rana 2001, Mitra 2003). It has been subsequently reported that such playground computers also seem to help children with school work, and may, indeed, have an impact on their social values (Inamdar 2004 and Mitra 2004).

In this paper, we report on the results of an experiment, conducted from 2001 to 2004, attempting to measure and verify the above results.

2. The experimental environment

Playground computers, such as the one shown in Figure 1, were constructed in 31 locations, 21 locations being in rural India, 6 locations in urban slum areas of New Delhi and 4 locations in rural Cambodia. A total of 100

Figure 1

Typical playground computers in village Bishnupur, West Bengal, India

computers were distributed over these 31 locations, the number of computers in each location being determined by the number of children in that area (we considered a ratio of 200 children per computer, based on an earlier estimate).

No instructors were appointed in any location, and, indeed, there were none in most of them. The village playground computers were usually located in primary school playgrounds. We appointed a caretaker at each location to turn the computers on and off everyday. The computers were kept on from around 8am to sunset, every day, including holidays. Of the 31 locations, 9 locations had computers connected to the Internet through satellite. We could not provide the Internet at all locations due to financial constraints.

3. Design of playground computers

Personal computers (PCs), such as those used in homes and offices all over the world, are designed to work indoors, usually in a carefully conditioned and controlled environment. Such computers can not be placed in outdoor environments, without air-conditioning and with poor power conditions, such as those prevalent in rural India and Cambodia.

Over the period of the experiment, we evolved a design for an enclosure that would enable the usual personal computer to function in an outdoor environment. The enclosure consists of a brick structure resembling a narrow hut with the computer screens visible on the outside of the hut through glass panes fixed to rectangular “holes in the wall” on one side of the hut (Figure 1).

The conventional mouse used with home or office PCs does not function effectively for more than a few days when exposed to outdoors weather. We devised a new solid-state mouse (called ToBu) without any moving parts. The mouse consists of six small metal circles embedded on a plastic plate (Figure 2). These are called touch buttons and need only to be touched with a finger to activate their functions. Four touch buttons on the bottom part of ToBu are used to move the cursor in the left-right and up-down directions, and two touch buttons on the upper part of ToBu are for left and right “clicks” of a normal mouse. The cursor can also be moved diagonally using a combination of the four touch buttons that control movement.

Figure 2

The monitor, keyboard, Perspex cowl and the ToBu mouse, shown enlarged, in playground computers

The keyboard and the ToBu mouse project out from below the monitor through the same rectangular opening in the wall. They are covered by a Perspex cowl that protects from dust. The user inserts his or her hand from under the cowl. The opening below the cowl is wide enough only for small hands to enter (Figure 2).

A metal lid, called the 'faceplate', covers each monitor and keyboard combination. This is opened during operational hours and forms a sun-shade over the computer. The height of the faceplate and lid are such that adults would need to stoop down at an awkward angle to see the screen. There is a seating rod in front of each computer, placed at a distance from the wall such that it is uncomfortable for tall people. These design elements are necessary to ensure that only children (usually 13 years of age and under) access these computers. In rural settings in India, where many adults would not have seen a computer, there is a great deal of curiosity about the device and this can, sometimes, lead to situations where children are not given a chance to operate the computers.

Each playground computer is equipped with a web camera and a microphone. All electrical power is conditioned at the input to correct for voltage spikes, over and under voltage and frequency fluctuations. Four hours of battery back-up is provided for each installation. Sensors inside the enclosure and related software enable us to remotely monitor the following:

a) temperature, humidity and illumination levels inside the enclosure;
b) electrical conditions;
c) mouse movement history (when the mouse was moved last);
d) history of applications run on each computer;
e) screen images on each computer;
f) images of children using the computer;
g) voice recordings of children speaking; and
h) history of sites visited on the Internet.

In addition, software controls ensure that:

i. no essential software of data is deleted or renamed,
ii. the desktop icons are not removed,
iii. the system closes unused programs, and
iv. the system restarts when and if a computer hangs.

The entire arrangement, as shown in Figure 1, is usually placed such that the screens face the north-east. This is to avoid glare from sunlight on the screens. Such playground computers are placed in safe, public locations where their screens are clearly visible to passing adults. This ensures that there are few or no attempts at vandalism, theft or the usage of the computers for accessing pornography or other undesirable material.

Amongst the 100 computers placed in the above manner throughout rural India and Cambodia, 4 have been damaged due to vandalism and the access to pornographic material has been estimated at 0.3% of available time, during the four years of the experiment.

4. Design of a test for computer literacy

In order to study the effect of playground computers on computer literacy, it was essential to devise an instrument that measures such literacy. While several tests exist, they are difficult to administer in the playground. A test was devised that involves a child's ability to describe the function of common icons on a Windows based computer. While it is true that not all users of Windows use icons, we found that the ability to describe or even guess the function of each icon was higher in those users who were familiar with the application whose icon they were describing (Mitra 2003, 2004). The test is called the 'Icon Association Inventory' and its results correlate well with traditional tests of computing literacy. The test consists of 77 commonly used icons in the Windows environment that the user has to describe. We administered the test to 74 adults in offices (a detailed validation study of the Icon Association Inventory test is to be published elsewhere) and the results showed an average score of 49%, with a standard deviation of 18%. The maximum score obtained was 76%, while the minimum was 7%. The results seemed to indicate that users, irrespective of whether they used icons or not, could guess the function of an icon provided it was from software that they used frequently. For example, a secretary who uses a word processor often would be able to guess the function of the icons of word processing correctly, while, if the job does not involve using spreadsheets, he or she would not be able to guess the functions of the icons used in spreadsheets. The test can be administered in about 20 minutes and uses a few sheets of paper and a pencil.

The spreadsheet program MS-Excel was not provided at any site. Also, since most of the children are not literate in English, they do not create English text. As a result, one would expect them not to know the meanings of the icons related to spreadsheets and text formatting. We observed that the icon recognition scores for Excel and text formatting remained close to zero during the nine month period. This can be interpreted as a control that confirms that the ability to recognise icons was caused by the playground computers alone and not from any other sources of information such as computer courses, teachers, etc. Most formal courses in computing would, invariably, have word processing and spreadsheet fundamentals as a part of the curriculum.

5. Experimental Procedure

At each location, a group of 15 children (referred to as the 'focus group') were selected at random from the children present near the playground computers on the day of inauguration. Usually, all the children in the village where the computers were being installed would be present, the occasion being an unusual one. The focus group was tested for computer literacy using the Icon Association Inventory test on the day of inauguration, on the seventh day, and every month for nine months, the duration of the study.

At the end of the ninth month, a control group of 10 children are identified. These are children from the village where the computers are installed or from a neighbouring village without computers. The attempt is to select a control group such that the only difference between them and the focus group is in their not having worked on playground computers. In this context, it is important to mention that a control group is not identified on the first day but only at the end of the experimental period. It is important to do this since we found that simply administering the Icon Association Inventory test on the first day made children curious about computers. Thus, it is difficult to say that the control group had no exposure to the playground computers. We, therefore, decided to identify the control group only at the end of the experimental period.

At the end of the ninth month, we also selected another group of 15 children at each experimental site. These children were selected on the basis of their frequency of usage of the playground computers. These frequent users were identified by a peer interview process and these children were selected such that they were not a part of either the focus or the control groups. Once identified, the control and frequent user groups were tested for computer literacy.

The procedure described above was applied to 21 rural locations in India. The locations ranged three thousand kilometres from the north to south – from Himalayan mountain villages to the ocean villages on Kanyakumari at the cape of the Indian Peninsula. Also three thousand kilometres from the west to east, the locations ranged from the desert villages of Rajasthan to the Ganges Delta in the Sunderbans. Such a wide distribution of villages ensured that the data collected were from children with diverse cultural, socio-economic, genetic and educational backgrounds. This geographic spread also ensured diversity in climatic conditions ranging from very low to very high temperatures, humidity and dust conditions. This was important for testing the robustness of the design for playground computers.

6. Results

Figures 3 and 4 below show the results obtained over the nine month experimental period from 21 villages. Figure 3 shows the average scores in the Icon Association Inventory test for all children in the focus groups, control groups and frequent user groups on the first and last day of the experiment. The national average scores for the focus groups are seen to rise from 6.65% to 43.07% while the scores for the control and frequent user groups are seen to be 6.94% and 43.73% respectively on the last day of the experiment.

Figure 3

<u>Icon test without Excel & text format – Inauguration to nine months</u>
(Average scores for the three groups)

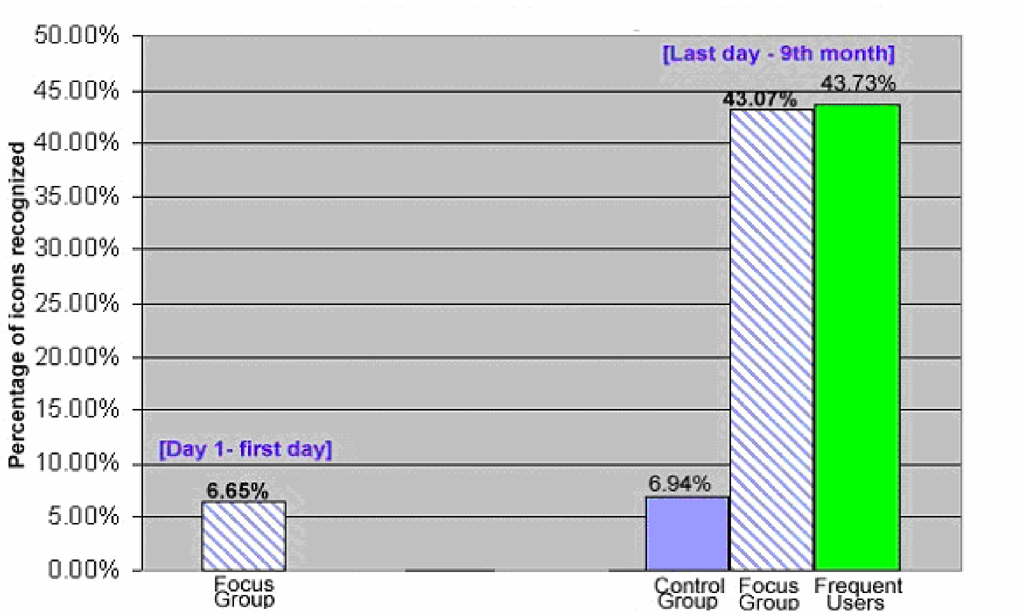
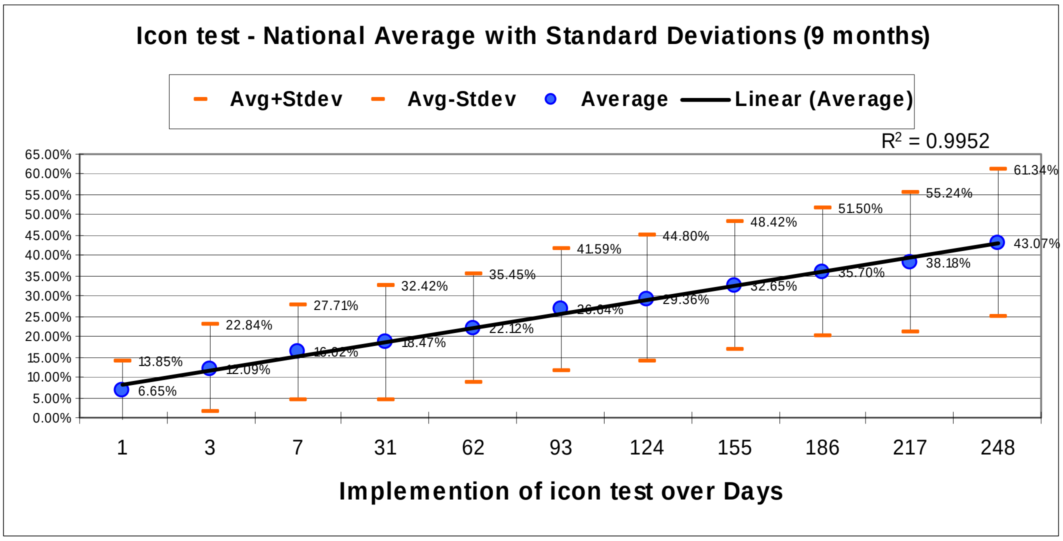


Figure 4 shows the average national Icon Association Inventory test scores for all focus group children over the experimental period of 248 days. The standard deviations are also shown in the figure. The average score is seen to rise from about 7% on day 1 to about 43% on day 248.

Figure 4.

<u>Averages with standard deviations for nine months</u>



6. Conclusion

The data reported above provides conclusive evidence that groups of children are able to learn how to use computers on their own, if they are given access to a computing facility. Such a facility needs to be provided to them in a safe, public location, such as a school playground.

Given the diverse locations chosen for the experiments reported above, it is suggested that this ability of groups of children to learn on their own is independent of who or where they are. In other words, economic, social, geographical or other factors do not seem to affect their ability to self-instruct in groups. Such group self-instruction does not seem to happen within a school, possibly because the learning groups cannot be diverse enough. Schools segregate learners by age bands and usually do not permit or encourage mixing of different age bands. The ‘hole in the wall’ experiment, on the other hand, places no restrictions on the constitution of a learner group and, in fact, this experiment does allow groups consisting of very young and older children and sometimes even adults. There is also no gender restrictions as there may be in certain social situations. Other experiments (Inamdar, 2004) have suggested that the ability of children to learn in heterogeneous groups may extend to subjects other than computer skills.

We conclude that playground computers, particularly those connected to the Internet, form an alternative instructional environment that produces predictable outcomes at a low cost. The ‘hole in the wall’ seems to be an effective method for ensuring computer literacy in regions where other conventional resources are not available. In addition, such public computers can provide an alternative to classroom education in areas where classrooms do not exist because they have been destroyed due to natural disaster/war, or they are too expensive to build, or they are in areas where teachers are reluctant to go. We recommend that such playground computers would be beneficial for all primary schools and public spaces frequented by children.

References:

Inamdar, P. (2004). “Computer skills development by children using 'hole in the wall' facilities in rural India”, *Australasian Journal of Educational Technology* 20(3), 337-350.

Mitra, S., Tooley, J., Inamdar, P. and Dixon, P. (2003). “Improving English pronunciation - an automated instructional approach”, *Information Technologies and International Development*, 1(1), 75-84, MIT Press.

Mitra, S. and Rana, V. (2001). “Children and the Internet: Experiments with minimally invasive education in India”, *The British Journal of Educational Technology*, 32(2), 221-232.

Mitra, S. (2000). Minimally invasive education for mass computer literacy. Presented at the CRIDALA 2000 conference in Hong Kong, 21-25 June.

Mitra, S. (2003). “Minimally Invasive Education: A progress report on the "Hole-in-the-wall" experiments”. *British Journal of Educational Technology*, 34(3), 367-371.

Mitra, S. (2004). The Hole In The Wall, *Dataquest (India), Sept. 23 issue,* http://www.dqindia.com/content/industrymarket/2004/104092301.asp#interact

(verified 4 April 2005)

Padmakar, P. and Porter, H. (2001). “The hole in the wall machine”, *Time Magazine*, Asian edition, 3 September, p.16.

Sweatshops and Butterflies (2001). India: Hole-in-the-Wall. [verified 4 April 2005] http://www.greenstar.org/butterflies/Hole-in-the-Wall.htm

The Hole-In-The-Wall (2003). [verified 4 April 2005]

http://www.niitholeinthewall.com/

Wullenweber, Walter (2001). “Das loch in der wand”, *Stern Magazine*, No. 42, 11 October, pp 97-102.