An Office "Hole-in-the-Wall" Exploration

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Summary

Using the debate around the "Hole in the Wall" experiment for children as a starting point, we ask a set of related questions around unrestricted PC access and learning, but in the context of adult non-information workers from low-income backgrounds in emerging market settings. Our central interest in this exploration is to understand whether and how free access to and unrestricted usage of a shared-access PC and the Internet at the workplace, translates to a variety of meaningful changes and welfare gains among the support staff at an urban corporate facility in southern India. Over the first five weeks of the intervention, we find usage increasing over time, though differentially among various support staff sub-groups. Entertainment-related applications (games, multimedia) and websites ("YouTube", "raaga") constitute the dominant content accessed by the staff. There is evidence of both intense individual exploratory usage by novices, along with extensive group usage and peer learning dynamics. The degree of personalization of the PC by users (changes to desktop background almost at every session) indicates a sense of ownership of the device. Preliminary measurements and feedback point to increases in worker morale and self-esteem over the course of the intervention. We highlight these observations as we propose additional questions going forward in this study.

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"I want to help in this world – I want to know about computers. I want to discover, invent even for 10 people - as a human being. No one in my family has done this. I need encouragement."

- Soma (Security Guard)

I Introduction

In 1999, Dr. Sugata Mitra – a senior executive at the National Institute for Information Technology (NIIT) – began a series of computer-based education experiments with children from disadvantaged communities in New Delhi, India. He started by simply creating a hole in the wall that separated NIIT from the neighbouring slum settlement, and had an internet-connected PC set up facing the settlement. Over the course of a few days, the children of the slum communities in the vicinity (mostly aged between 6 and 12) began taking a keen interest in the device and started exploring PC usage on their own. Tracking their activities and skill acquisition on the device revealed that such "minimally-invasive-practices" could produce significant learning results. Many of the children became computer literate in a few weeks' time, without any formal instruction at all. While the terminology they used to describe their computer interactions was colloquial, it appeared that these groups of children had taught themselves and each other basic PC functions that allowed meaningful interactions with the computer and the Internet. This self-learning capped at a certain level, but simply having unfettered access to a technological device in a public space had allowed for a certain level of computer literacy and the corresponding access to information, knowledge and opportunities that that entailed [1] [2] [3] [4] [5] [6] [7].

While the project gained a lot of positive publicity, it also attracted criticism for being "technologically deterministic". Critics were skeptical that simply having physical access to an IT device and learning a set of basic IT skills would translate into any systematic improvement in the lives of these children. Further, many worried that the introduction of a device in a community without any consultation with the families in the process of conceptualizing, designing and implementing the intervention could unleash disruptive local social dynamics. Warschauer summarizes this view well when he describes the "digital divide" not as "gaps to be overcome by providing equipment," but as "social-development challenges to be addressed through the effective integration of technology into communities, institutions, and societies" [8]. He further comments, "what is most important is not so much the physical availability of computers and the Internet but rather people's ability to make use of those technologies to engage in meaningful social practices" [8].

Using the debate around the "Hole in the Wall" as a starting point, we ask a number of questions around PC access and learning, but in the context of adult non-information workers from low-income backgrounds. These include: Does the learning benefit of unfettered, unaided PC access extend to adults? How does PC learning occur among adults? What kinds of PC-based applications are most interesting to non-information workers? Does such learning impact workers' morale? Does this impact their long-term welfare? And finally, would the provision of free PC access at the workplace to non-information workers make business sense for a corporation? Going a step further from this initial set of "yes/no" research questions, we also look to ways of deconstructing the limits of a "technologically deterministic" approach, i.e. understanding the enabling conditions under which access to and use of a PC and the Internet translates into a variety of meaningful changes and welfare gains.

In this report, we present first-stage results of this exploratory study. Section II presents findings from a set of baseline interviews we conducted with support staff workers at our office facility, on their understandings and preferences around information technologies. In section III, we describe our intervention that introduced a dedicated Internet-connected PC for support staff use within the Microsoft Research India office facility. Section IV showcases our findings over the first five weeks of the PC's use by the office support staff, including application and Internet usage patterns, learning dynamics and initial observations around impact. We briefly discuss our findings in Section V, and conclude with limitations and next steps in Section VI.

II Baseline qualitative study

Our interest in understanding the learning and welfare benefits of unaided PC access for non-information low-income workers stemmed in part from the results of a qualitative study on the value of information technology (IT) to non-information workers conducted with the support staff at the Microsoft Research India office facility in Bangalore in August-October 2006. We elaborate on particularly relevant insights from the initial qualitative study below (for more details, see [9]).

II.I Profile of support staff

Table 1 summarizes information on job type, educational qualification and monthly salary of the respondents in the study. We see that the average worker interviewed earns ~$100 in currency terms, or ~$400 in purchasing power terms, per month. This puts all our respondents above the "poor" category (crudely defined as $2 per person per day, $60 per month), but well below the middle income category[1] (monthly income of Rs. 7,500 or $178 in currency terms, i.e. ~$750 in PPP). The lack of any systematic correlation between educational attainment and salary outcomes is also stark. Driving, for instance, commands a higher average return than most of the other occupations, despite the drivers having, on average, lower educational attainment than the other workers. It appears that earnings vary more so on the basis of particular skills than formal schooling completion in these occupational categories.

Table 1: Hierarchy of job types and correlation with schooling and salary

Job type	Number of respondents	Average years of schooling	Average monthly salary (Rs./ US$)
Housekeeping	7	11.9	3064 / $73
Office assistant	2	12.0	3300 / $79
Security guard	11	13.6	3946 / $94
Building Maintenance staff	2	15.5	4350 / $104
Driver	6	10.3	6167 / $147
Security officer/ Transport supervisor	2	14.0	6500 / $155
TOTAL	..	12.6 (~Class X)	4338 / $103
No. of respondents (n)	30	..	..

Note: US$1 ~ Rs. 42 (May 2007)

[1] "The Great Indian Market: Results from the NCAER's Market Information Survey of Households", August 2005, National Council for Applied Economic Research, http://www.ncaer.org/downloads/PPT/TheGreatIndianMarket.pdf

The workers were predominantly young male migrants (only two women support staff in the office complex), with the majority being first-generation urban dwellers, who continued to have a strong presence in rural India (visiting their family each month, sending remittances, etc.) even as they worked in the city. A little less than half of the workers were married. Their job history revealed very high job turnover rates, with the workers having earned their income through a range of wage labour, farming, small enterprise, and other jobs before arriving at this job. It is therefore very possible that we could have met the same workers in the agricultural or in the urban informal sectors a few years ago. The majority of the respondents had attended government schools where the local language (Kannada, Telugu or Tamil) had been the primary medium of instruction. Hence, familiarity with English as a medium of communication and information usage was low.

II.II Very high valuation of the PC

Exposure to technology varied widely across those interviewed. Two-thirds of the workers reported ownership of at least one mobile phone and a television in their homes. In fact, one in three mobile phone owners among the staff had already acquired a second mobile phone for their families. On average, there were more mobile phones and televisions per family across the group, than there were cooking gas cylinders (LPG), which provides some indication of the importance these devices have acquired in the priority list of household purchases. In contrast, all except one of the workers did not yet own a refrigerator and no one owned a car as yet.

The valuation of the PC among the workers interviewed was uniformly high. All except two of the workers rated the PC as being either 'Important' or 'Very Important' (on a 4-point scale) for them to get ahead in life. In the context of their children being able to get ahead in life, every single worker rated the PC as being 'Important' or 'Very Important'. In describing the reasons for this high valuation of the PC, they described the close linkage of computers with societal progress in science and engineering ("*Computers are very important for scientific reasons: for sending satellites, and then checking where they are and whether they are working properly*") and in macroeconomic management processes (accounting and financial systems in particular). And yet, the same device was simultaneously perceived as a driver of individual progress, given that "*10 or even 100 people's work can be done by 1 person using a computer*," and the perception that "*with a computer, you can get a better job (even within this office).*" The PC was seen as a handy, if not vital tool, with which to arm oneself in a modern, scientific world ("*If there is a computer, wherever you go, you can make a life*").

However, while the workers held these powerful images and strong valuations of a PC, there was a significant gap in their ability to describe the nature in which the PC enabled such outcomes for individuals and societies. For instance, in describing PCs as educational tools, a worker commented: "*Students now learn Windows - how to open it and use it, what's inside it, games, etc. - and I cant say why exactly that is useful, but it is. But I know there is something in the computer that is important for students.*" There is a sense that what the PC delivers is important, without a very clear understanding of what content or functionalities the device provides children. Similarly, a worker described 'search' as: "*If you put in one word [in a computer], hundreds of words will join to that word. There is lots of use from that.*" There is a sense of ambiguity in how or why a given word is entered, and how or why the results involve a barrage of additional words, that appear to hold value. The functional use of the PC to achieve high payoff outcomes, therefore, remains shrouded in uncertainty. As a worker aptly described the

activities at his workplace, "*In this office, each person is doing some project. So they type into the system. I do not know about the interior, i.e. why and how they use the computer exactly to complete their job.*" This brings us back to the initial Warschauer comment on how there is far more to understanding and benefiting from a technology like the PC than its simple physical proximity.

II.III High valuation does not translate to PC adoption in regular lifestyle

Given the high valuation of the PC, we expected to see a high level of interest in PC usage, adoption, and final acquisition among the workers. Two workers had indeed purchased assembled PCs for their homes that were predominantly used for offline entertainment purposes (music, films, etc.) in one case, and for a relative's ongoing educational preparation in the other. A quarter of all workers in the group were computer novices and had never touched a PC before. The bulk of workers, however, fell in between these two extremes, having had some exposure to a PC in the past. Interestingly, the 12 workers who reported having received some IT training in the past, either at secondary school or at a computer training institute, attributed their ability to use individual PC applications to friends or colleagues who had informally guided them through various interactions with a PC, not to their formal instructors. Yet most workers had not pursued PC usage beyond these initial interactions. In an urban setting where shared access to an internet-connected PC at cyber cafes costs as little as Rs. 20 (~$0.5) for an hour of use, the low usage of such facilities given the high expressed valuation of the PC and expected benefit was surprising.

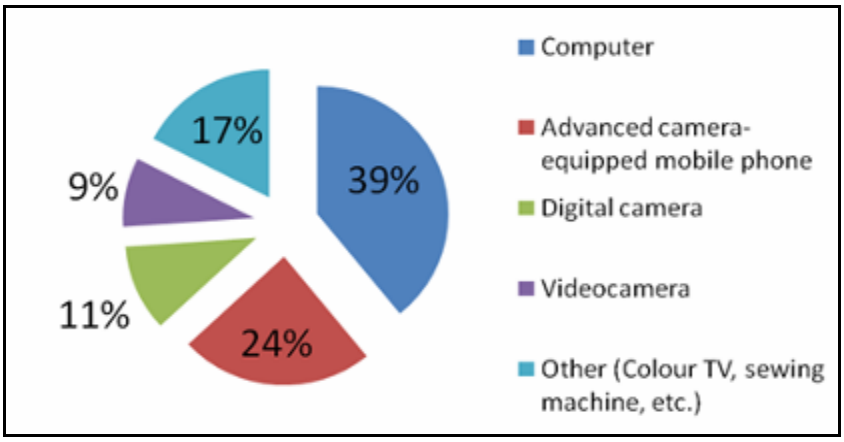


Figure 1: Choice of next technology purchase (n=30)

In this context, the workers' responses to a hypothetical question on their next technology purchase (phrased as follows: "If you had a gift voucher for Rs. 20,000 (~$500) at a local durables/ electronics store, what would you purchase?"), revealed an interesting set of issues. Despite 28 workers rating the PC as a key component of enabling a better life for themselves, even when money was not the issue, only 12 picked the PC as their next chosen technology purchase. A number of workers who didn't yet own a television picked that as the next purchase, with their reason for the choice revolving around the widespread accessibility of the device ("*I will buy a colour TV - see films, pictures, news. Everyone can use.*") Others picked a videocamera as a good business/family investment ("*With a videocamera, whether in-house or outside 'functions' (events), you have to pay for it. So if we own it, we can use it both for ourselves, relatives, and friends (save money), and to sell the service to other people (earn money).*")

A number of others picked a camera-enabled mobile phone, with their explanation pointing to the "value for money" proposition implicit in the price point of advanced mobile phones ("*Could buy 2 camera phones with the same voucher. Will not get a 'good' computer for $500*.") The decision not to pick a PC was best explained by a worker who commented, *"One should know how to operate something and only then buy it."*

Using these responses from the baseline interviews as a springboard for deeper understandings, we directed our attention to the four key factors described as drivers of technology adoption by the workers: Affordability, Accessibility, Utility and Ability.

III Implementation of the Intervention

Returning to the original set of "Hole in the Wall"-related questions that inspired our investigation, in the context of the staff interview responses, we honed in on three particular strands of inquiry:

(1) Will unfettered and free access to a PC at the workplace inspire usage by support staff?

(2) What kinds of PC usage will emerge in the absence of formal structure and training?

(3) Does such PC usage/ basic IT skill acquisition have any effect on workers' lives, livelihoods? Does it affect the employer organization?

To test these questions, we set up a simple intervention involving the introduction of a PC for the exclusive use of the office's support staff. In this, the aim was to take care of the "affordability" and physical "accessibility" barriers to technology adoption, and focus on understanding the "utility" and "ability" barriers.

The project setup involved the installation of a standard Windows XP-based PC in the basement of the office building. This location was chosen as it is where the housekeeping services office, employee changing rooms, and other staff facilities are located. It was therefore chosen as a convenient and accessible location for the staff, especially those whose regular work did not involve entering the office building (e.g. drivers).

The PC had Windows XP Professional as the operating system and was a clean install on a formatted hard-disk. The only additional software installed was Microsoft Office XP. The system was kept as "clean" as possible, given that one of the research aims was to see how a simple public PC set-up was transformed with use over time, i.e. what applications are added and what settings are modified. Other features included broadband internet connectivity, a Logitech webcam for users, audio speakers and headset, and a scanner-cum-inkjet-printer.

Figure 2: The Office "Hole-in-the-Wall" set-up

Logging software was installed on the PC to enable tracking of actions and applications. Users were informed of this privacy aspect at the initial informational meeting introducing the project, and through printed notices pasted at the location (both in English and the local language Kannada). Logging was done in a threefold manner. First, motion-triggered video logging was conducted from two angles: one behind the PC looking at the users, and another from behind the user looking downwards at the PC. Audio was to be recorded, but the acoustics of the basement and the microphones were problematic so the audio recording option was disabled. The second aspect of logging involved periodic screenshots, taken once a minute to record on-screen activity. The final component was a derivative of the VIBElog logging tool that has been developed by the VIBE group at Microsoft Research, and adapted for shared access PC logging [10]. This is a background application that logs all behaviours and events taking place on a PC, and can provide a high resolution of details to the extent of logging when a window is resized, closed, or opened, and even logging details of what URLs are being looked at in Internet explorer, window titles, etc. The logging data, images and videos were synchronised into another PC on the network, for back-up and remote access.

Once the computer was installed, all the support staff at the office facility were invited to an initiation information session. At this meeting, the new facility of providing free PC and Internet access at the office for all workers was described. The PC could be accessed by any one of the workers after the completion of their regular work. There were no restrictions placed on what the PC could be used for. It was also explicitly mentioned that all activities on and around the PC would be continually recorded, for both security and research purposes. All questions around the PC facility were to be directed to any members of the research team.

In the following sections we discuss observations from the first five weeks of use of the Office "Hole-in-the-Wall" PC. For the research team, an important guideline in the first phase of the project was not to help users in any specific task around the PC, in order to see if and how learning and usage took place without any external or formal instruction interventions for the same. However, the research team did assist in case of hardware or connectivity failure, though such instances were rare.

IV Results

The video data collected was analysed by a Research Assistant using a custom-built software tool that allowed browsing and replaying of the data, synchronising the screenshots, videos, and data-logs together on the same display. The data log files were processed separately to analyse specifics.

Based on the baseline interviews, the staff were also categorised into one of four User types in terms of their pre-intervention PC exposure and usage (Novice, Beginner, Periodic or Expert user). Figure 3 and Table 2 below describe the categorisation and the proportion of respondents in each category.

Table 2: Categorisation of User types based on previous PC usage

Categorisation	Past Exposure to and Usage of a PC
NOVICE	Have never used
BEGINNER	Have used at least once before, but don't use now or use once a month or less
PERIODIC	Use a few times a month or a few times a week
EXPERT	Use daily

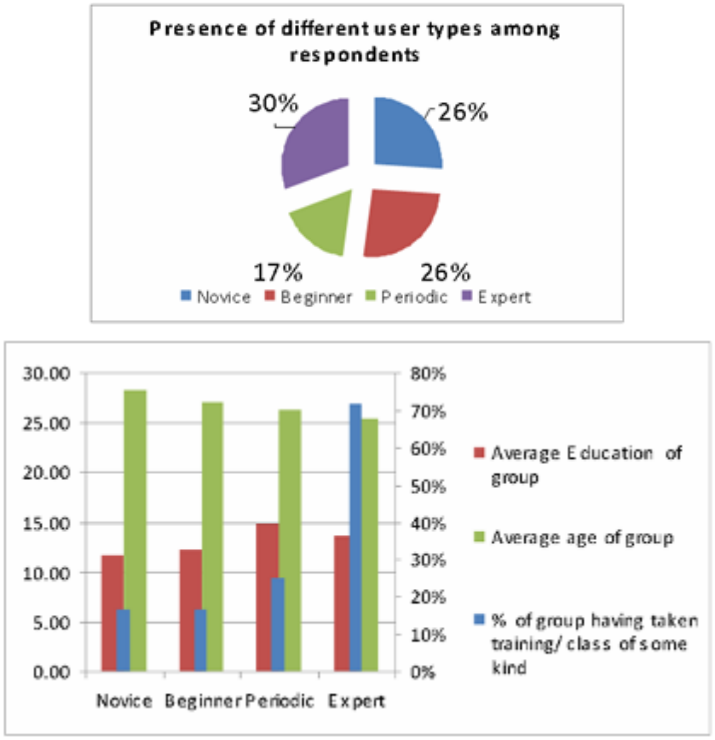


Figure 3: Baseline profiles and share of User types (n=30)

IV.I Overall Usage

The first metric involved measuring overall usage of the PC and correlating usage with particular subjects. A gradual yet distinct increase of usage over the five week period was observed (see Figure 4), starting out at 8.7 hours of overall usage per week during the first week to 14.4 hours during the fifth week. That usage increased over the first five weeks indicates that the PC's usage did not just involve one-off instances based on its novelty value, but that users were returning to the PC. There were approximately 40 support staff workers at the office facility over this period, including 2 women. Neither of the women staff used the PC at all in the five-week period.

Note was also made of who the users were, and an attempt was made to correlate user type with the qualitative interview data from Section 2. In the initial interviews, users were categorized into four types based on past computing experience (See Figure 3 and Table 2). Usage of the PC itself was further separated into two kinds of scenarios, 'primary' when the user is the main person operating the PC (controlling the mouse/keyboard), and 'secondary' when the user is not operating the PC directly, but is also at the workstation and is observing and paying attention to the usage. The usage of the PC by type of user is shown in Figure 4. As we can see, Novices and Beginners have a high share of 'secondary' usage, while Experts are for the most part 'primary' users. This correlates with other observations, which we will describe later, that a lot of the learning on how to use the PC seemed to happen socially – with a Novice user either passively learning by observing an experienced user, or alternately, an Expert actively teaching a Novice.

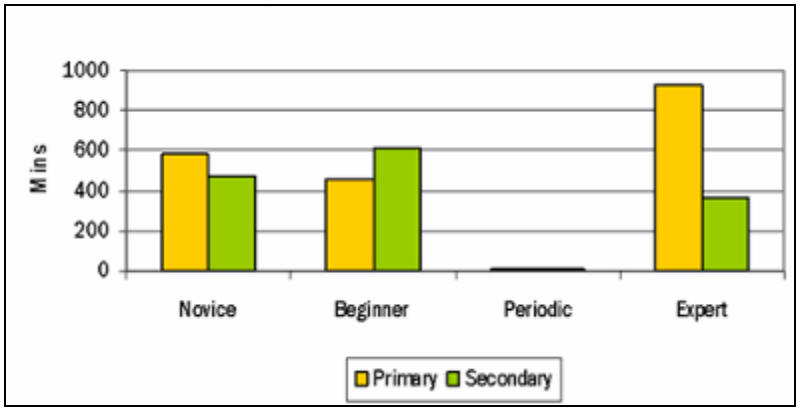


Figure 4: Variation in PC Usage by Baseline PC familiarity

IV.II Initial patterns of use

A second aspect of the study involved looking at qualitative behaviours around usage by studying the videos and the screenshots. Two broad categories can be used to describe the initial behaviour observed.

The first was with the users who were previously in the Novice or Beginner user categories. There was a lot of curiosity around the PC, and when it was set up, these users would often go and stand at the machine, though many seemed unsure about what to do next. Some looked on and left, while others tentatively touched the mouse and keyboard and tried to experiment. At these initial sessions, not much happened, but eventually the experimentation intensified, and many users started discovering that they

could move the mouse around and click on things. Screenshots indicate highly randomised clicking without any patterns, and consequently no sustained application usage, but over time, we observed that in multiple cases, this usage would eventually lead to one of the installed games being discovered, and the user would start playing that game. Most of the games shipped with the OS are quite straight-forward to use, but more importantly, they provide feedback so the clicking is not just random anymore, and it gets instrumental value such that something happens on the screen in response to the clicks, which engages the user. In comparison, random clicks in the OS shell, or in an application like MS Word do not result in anything that engages the user. This seems to be a reason that the dominant usage pattern in the very initial days by the Novice users was random clicking around the screen, followed by sustained series of screenshots showing game-play.

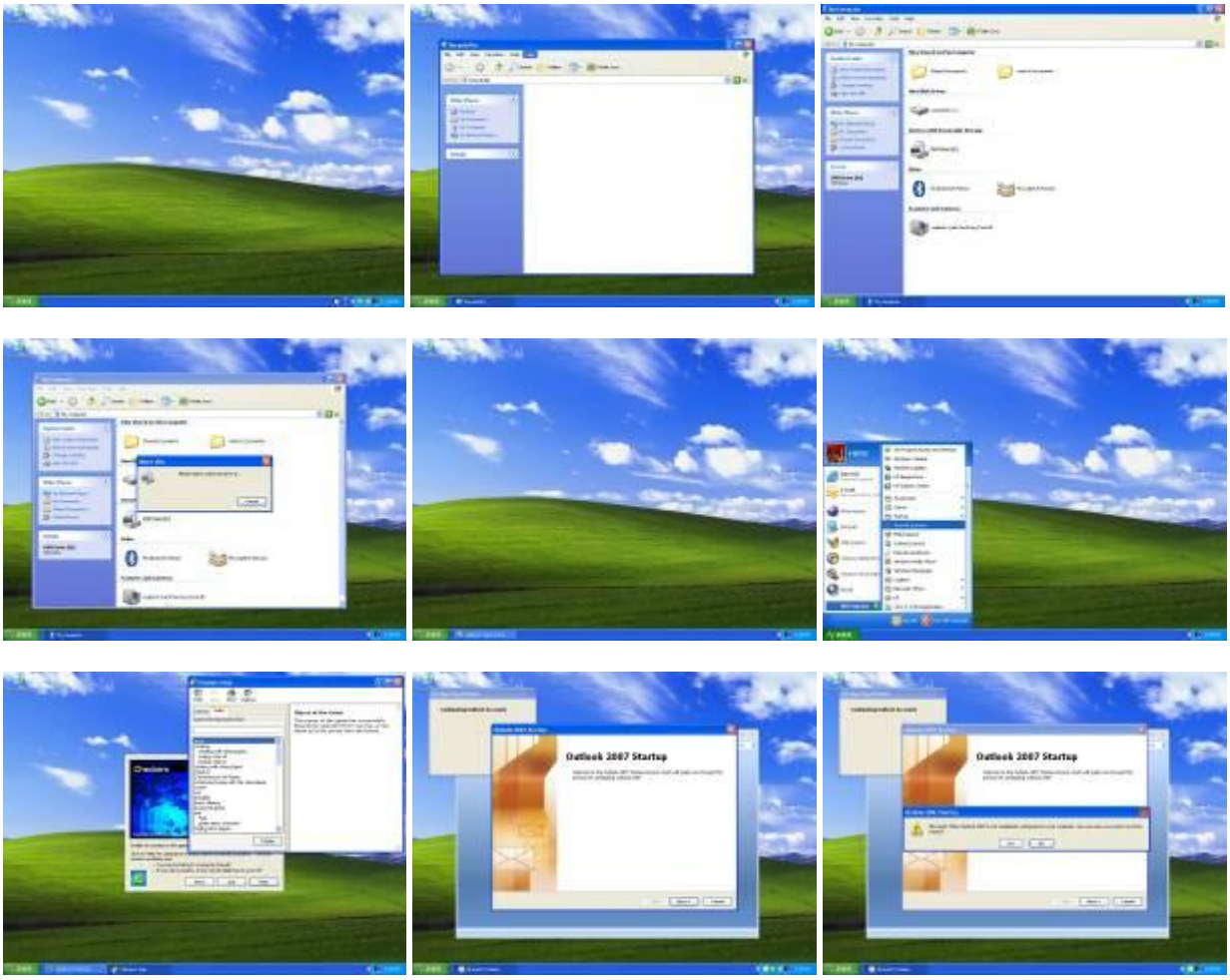


Figure 5: Patterns of exploratory usage by novice users

The observed behaviours of the second category of users (Periodic and Expert users) was varied, as it included those users who had prior experience with a PC. These users all seemed familiar with the internet, though how extensive their usage was varied. They seemed aware of basic activities such as changing settings and preferences. For instance, within 24 hours of setup of the machine, we noted that the desktop background was changed, and the default language that Google Search appears in was also changed to a local language (Tamil). Some users had checked email, while others had conducted basic search tasks.

IV.III Quantitative measures of application use

To take a deeper look at the behaviours occurring at the PC, after five weeks, the detailed log files were processed and analysed. Figure 6 shows the Application usage, which is measured here by counting the number of instances of the launch of a specific software application.

As we can see, half the application usage was dominated by browsing Internet Explorer. The remaining were a mixed group, but the main categories were 'Multimedia', 'MS Office' and 'Games'. 'Multimedia' refers mostly to applications such as music playback (some users got their own CDs too), and webcam software. The usage of MS Office was initially just for simple exploration. For instance, there were numerous files created on the PC, each of which was just a simple .DOC or .PPT file that just had a user's name typed in it, often embellished by special font and word effects. There were anecdotal references to cases where some of the expert users taught others to use MS Office, but in the initial five weeks, we did not observe significant tasks in the "office productivity" category.

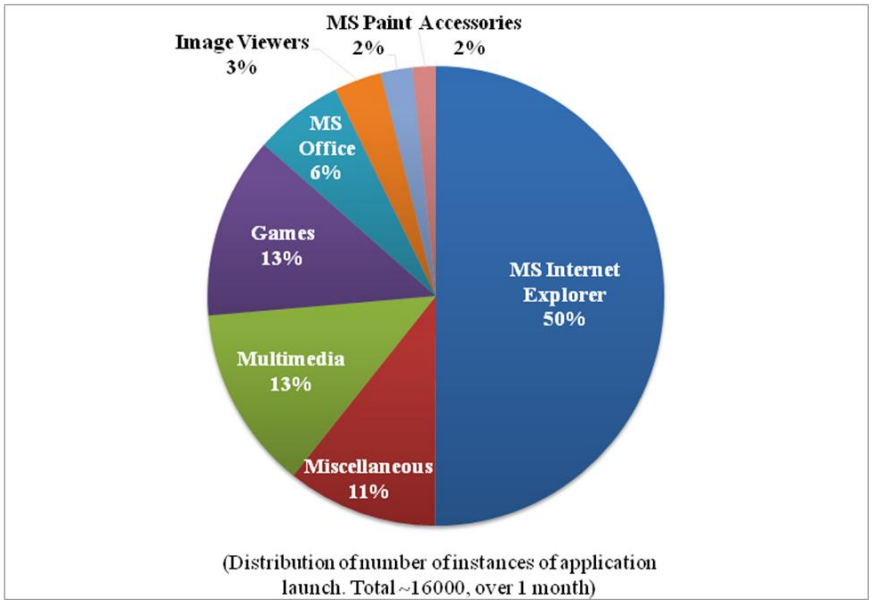


Figure 6: Application usage over the 5-week period

Game use was prominent, and in fact the metric of 13% is actually less than actual total game use, as we can see (on studying URLs visited, in Figure 7) that a lot of the game-play was also through applets within browsers. The games mere a mix of the default games that are shipped with Windows, along with new games played online, or downloaded from popular online-gaming sites. These were all simple games, rather than high-end ones of the 3-D or First Person Shooter variety, but users spent a lot of their PC usage on these games.

IV.IV Internet use

The logging software also took note of each URL loaded in Internet Explorer. These URLs were classified into varied categories by manual examination, and the distribution of URLs in these categories is shown in Figure 7. We can see that 'Music', 'Movies' and 'Entertainment' together ('Entertainment' usage) accounted for around 21% of total usage. This is in stark contrast to for e.g., accessing 'Job' based sites (which amounted to ~ 1% of URL counts).

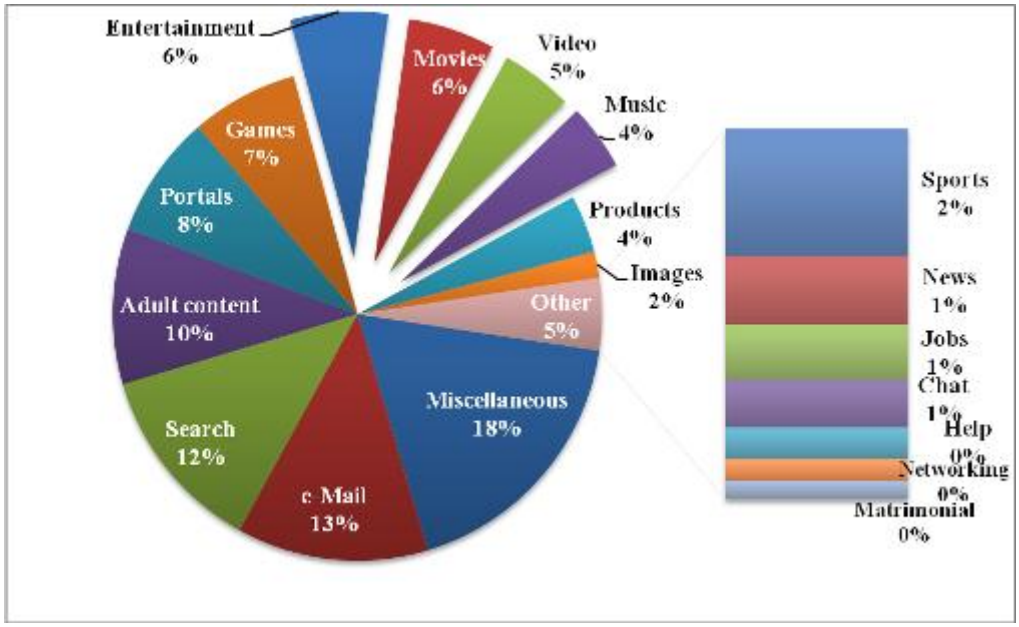
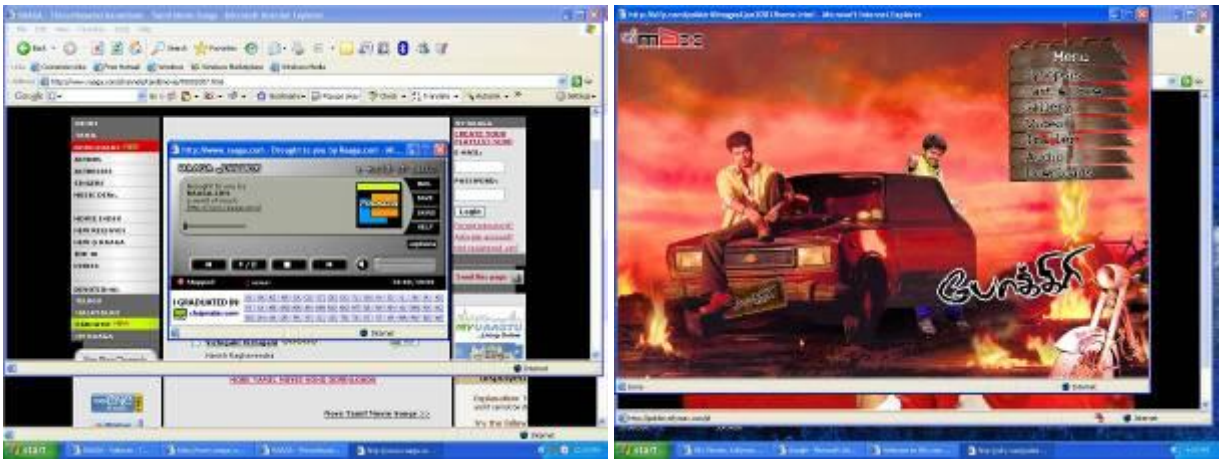


Figure 7: Internet usage over the 5-week period
(in categories of URLs visited, from the log data; overall, 14000 hits in the 5-week period)

The entertainment sites were mostly related to popular culture, specifically those catering to local language cinema, and the affiliated film-music and film-stars. It was noted that over the period of these five weeks, there was a distinct point when YouTube.com was introduced to the users, possibly through a forwarded attachment, or through an instance of some of the company's technical employees pointing it out. After that point, internet video became a very popular use. There are lots of scenes from popular Indian films online, and these were frequently viewed by users.



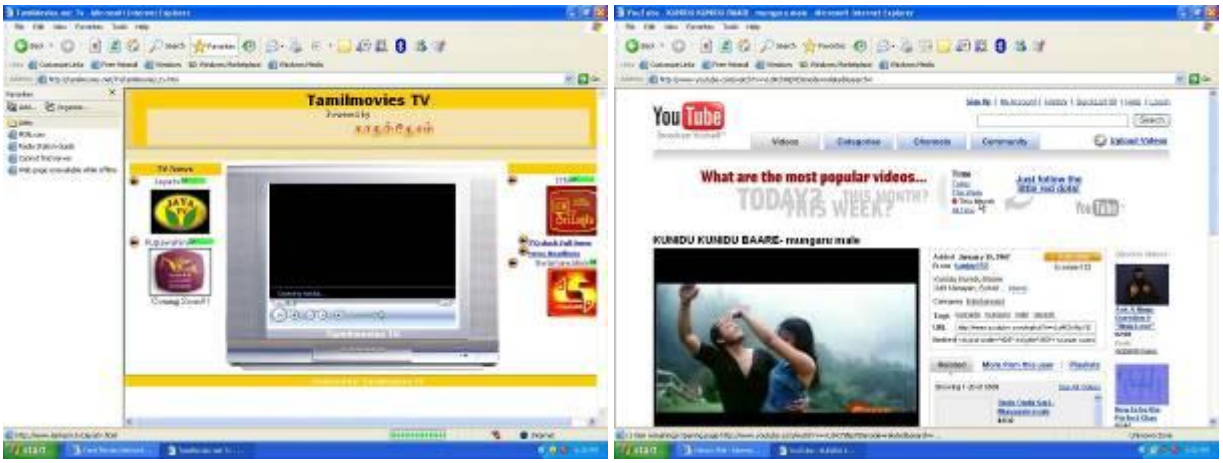


Figure 8: Sites with local language cinema and music content were very popular

The other popular category for URLs was web-search. This was dominantly Yahoo Search and Google, and search queries varied greatly. Entertainment, jokes and games were the primary search topics. However, searches extended to things as diverse as 'Britney Spears', 'James Bond 007' and 'handycams'. An interesting observation here was that several users attached ".COM" to their query of choice and typed it in directly into the browser address bar, instead of through a search engine.

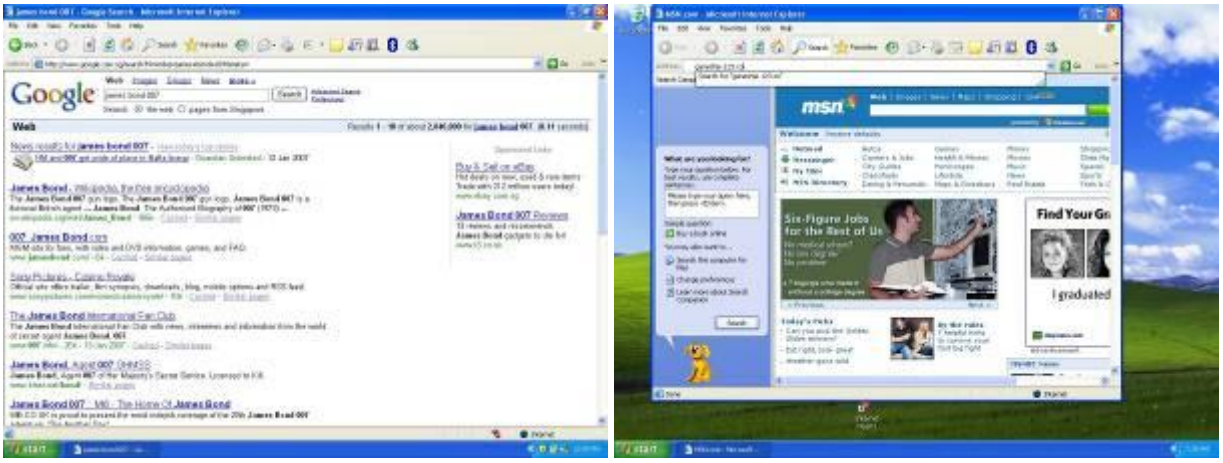


Figure 9: Search queries (note the entry of "ganeshje.123.co" into the address bar)

A point of note is that some awareness did seem to have developed around the concept of search as a tool to find answers on any topic. For instance, one of the earliest queries was "What is Microsoft?". At a later point, there was a celebration in the office by the research staff on the occasion of Valentine's Day. A search query noted that day was "What is the meaning of Valentine's Day?" It was interesting to note the staff's negotiation of this culturally unfamiliar concept through the Internet.

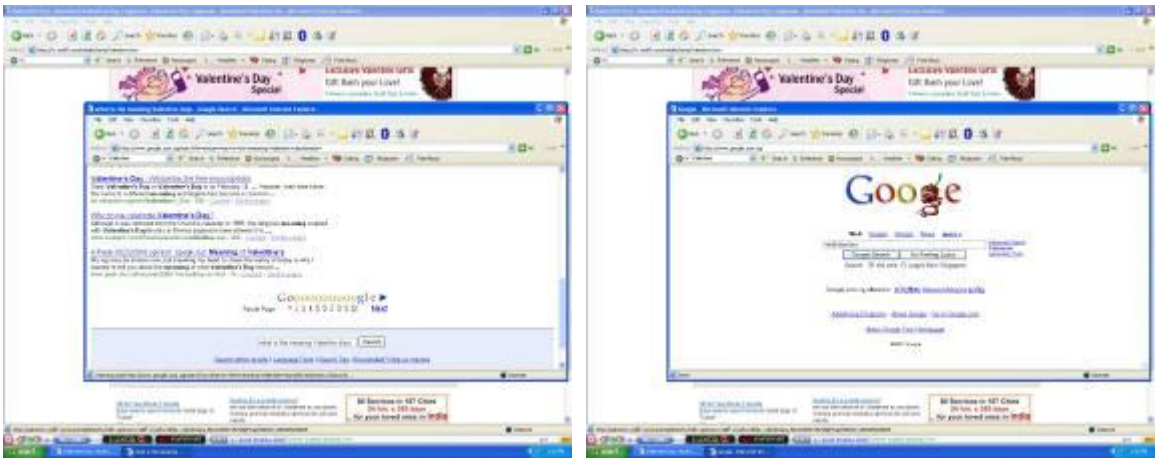


Figure 10: Search query for "What is the meaning of Valentine's Day?" on February 14, 2007

There was a measurable amount of pornography accessed, though from the video logs it seems that usage was limited to just a few users, and the sessions were sporadic with bursts of lots of site visits in a short time, and then nothing for many days. Looking up examination results was another reason for web-access cited in other scenarios such as cyber-cafes and kiosks, and some instances of that were observed here as well. Users also frequented local news and sports news portals.

IV.V Learning

The proposal for having a non-mediated and freely accessible computer that benefits users was based on the idea that users would learn computing skills from their interaction with the PC, and hence learning behaviours were a focal area of observation. From video analysis a variety of learning scenarios were noted. The two broad paradigms were individual learning and socially-situated learning.

All users learnt by exploring individually – we did see a lot of experimentation which lead to some insights and lessons that were re-used. For example, for a few users the internet is something that they chanced upon by accident while exploring offline applications and desktop icons. There were multiple paths observed. Some discovered the internet through an offline application – for instance, using Windows Media Player and choosing "Online Store" leads to the opening of an internet browser window with the music and media website. Similarly, some of the free games that ship with the OS have an online playing mode that results in the browser being launched and some other websites accessed. Another behaviour observed was that some users used the "history" drop-down menu in the browser's address bar to find and go to websites that other users had visited.

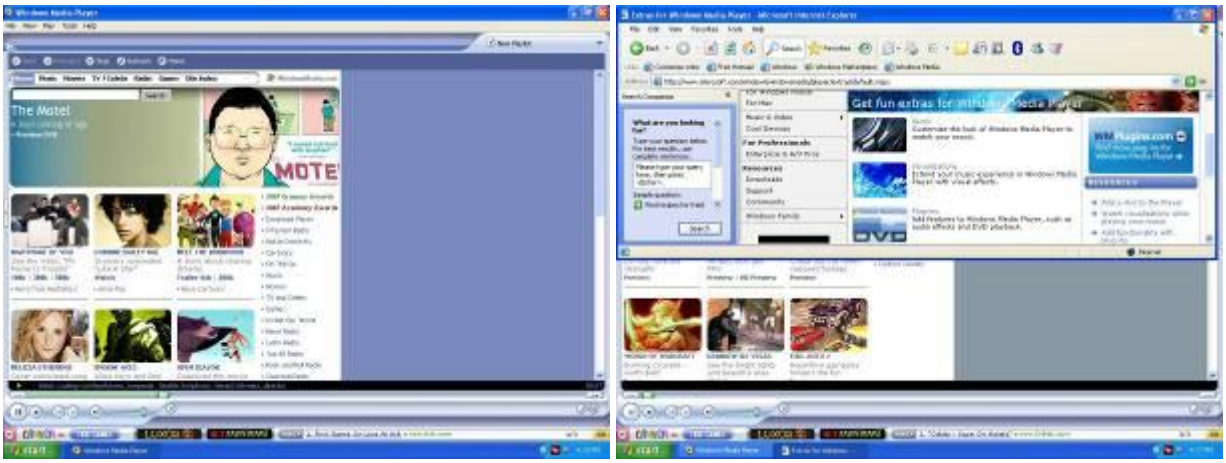


Figure 11: Discovering the internet

These kinds of exploratory behaviours were observed in various other applications too. In the five week period there were also 92 instances of "Help" being launched, with many Users resorting to "Help" to try and figure out things on their own. However, it did not always work. For instance, one user was unaware of how to type in uppercase in Word, so he tried to get an answer from the "Help" menu. In this case, unfortunately, "turn on Caps Lock" was not something that was mentioned in any help file.

Learning in group settings turned out to be a popular and effective mechanism for users to learn new PC skills. Most of the usage observed is of groups of people working on the PC together. At one extreme, the social scenarios were non-interactive ones, where a Novice/Beginner user would passively observe the expert user, and learn by observation. The intermediate cases involved the Expert user explicitly answering questions and teaching skills to the others. The other extreme involved scenarios with discussion and collaboration – joint exploration and activities, and these seemed effective in that a lot of the new activities (downloading and installing games, searching for movies, etc.) seemed to be done in this scenario.

The shared usage scenario is interesting in its potential for effectively allowing users to pick up skills and learn from their peers in a casual informal manner. The social nature of the interaction, for example watching movie clips together or listening to music aloud on the speakers, also seems to result in a more fulfilling and inclusive usage experience.

Figure 12: Individual exploration and group usage

IV.VI Miscellaneous observations

There are numerous behaviours observed that do not fall under the categories described so far. For instance, an extremely popular activity was changing the PC’s desktop background (see Figure 13). These would change in almost every session when a user started working on the PC. There was a great deal of personalisation and preparation in designing the desktop background, including photographing oneself with the webcam and then using that image as the desktop background, or taking a picture of other objects (like the privacy notice) using the webcam and tiling it as the desktop background. This seemed to indicate a certain level of ownership of the device, in users spending the time and effort it took to make the PC suit their preferences during their own usage, despite it being used in a shared access environment.

Figure 13: Personalised desktop backgrounds

Given the high ratio of users to device (40:1), the smoothness with which usage was shared across users was also a noteworthy feature during the five-week period. The heavy group use of the PC ensured that few users felt excluded from the PC when others were at the machine before them. Depending on the situation, there was an informal routine to when and how various users came to the PC, participated, moved on to individual usage in some cases, and then passed it on to the next user/s.

IV.VII Impact

A central question in our exploration was to understand whether exposure to a computing experience in the manner described above allows for a positive impact on the users' overall well-being. From one perspective, there is the likelihood that an increase in computing literacy might improve job opportunities, either within the same company setting, or even externally [11]. Other possibilities include improvements in self-perceptions and/or individual empowerment as a result of this opportunity and exposure to technology.

Five weeks is clearly too short a period to measure impact, especially around livelihood indicators. However, a psychological inventory for self-esteem was administered[2] before and after the 5-week period to see if there were any changes in that metric that correlated with the computing intervention. A marginal increase in the self-esteem scores of those 11 participants with before and after survey responses was noted, i.e. a 1.45 point increase was measured (6% relative to the baseline value) on a 0-40 point scale. This measure from our small sample clearly cannot be used as evidence of any systematic positive impact, particularly on fundamental behavioural aspects. However, these findings do inspire our interest in deconstructing the behavioural effects of PC usage, independent of measurable "objective" welfare impact.

More qualitatively, there appeared to be a palpable effect on staff morale. The staff seemed to enjoy the opportunity to have free and convenient access to the PC, and felt it was a "good thing". Learning new skills did result in a sense of pride and achievement, and there was a positive attitude towards the employer for allowing and providing such a facility (in contrast to most other offices where support staff do not have such access). Some comments from the users were:

"This is 90% a very good idea. When the computers are inside, it is difficult for us to feel comfortable touching them. Now, this is like a computer for us, outside."

"I felt so happy that day when we had the interview. For the first time I touched a computer and did so many things without a mistake….. I don't have an email account. So now maybe I can make one on this computer."

"No, I have not used it yet. I am waiting to get a book from my friend, you know the one on basic computers, so that I can try things on this computer."

As one user commented, "*listening to music makes me feel good – so I leave the office feeling happy*". To the extent that self-reported well-being is important, access to and usage of the PC at the

[2] We used the Rosenberg "Self-Esteem Scale" (translated into the local language) consisting of 10 items that were answered on a five-point scale ranging from **strongly agree** to **strongly disagree**. For details on the scale, please see http://www.bsos.umd.edu/socy/grad/socpsy_rosenberg.html

workplace, therefore, does seem to have a positive impact on workers' experience. At the same time, if indeed the PC is primarily serving a recreational need for the workers, we need to understand whether this need is fulfilled by any device that provides this entertainment functionality (TV replacing the PC) or if it is specific to the PC's offerings.

V Discussion

In this section, we make summary comments based on the results described, while also adding additional notes to address each of the three key questions raised at the outset.

A Will unfettered and free access to a PC at the workplace inspire usage by support staff?

Our preliminary analysis of a month-long experiment to provide free and unrestricted PC access to the support staff at a corporate workplace provides support for the proposition that the PC as a device is attractive to non-information workers, and that when constraints in accessibility and affordability are removed, usage of the PC does not just occur, but in fact seems to increase over time. However, usage of the PC is not uniformly distributed across the staff, with particular sub-groups showing higher propensities to usage than others.

Baseline skill – It was interesting to note that there was no clear linear relation between baseline PC literacy and usage. As Fig 4 shows, those at each end of the PC skill spectrum, i.e. the sub-groups of complete novices and expert users, were the ones who spent most time with the PC.

Gender and age – Neither of the two women among the support staff touched the PC, even though their work in the vicinity of the PC often triggered the motion detector on the camera. In some ways, the reaction of the women staff (both of them older and with children) mirrored that of many older male staff members. These workers cited the lack of time and difficulty in learning to use the PC as the reasons for their non-adoption. The familial responsibilities (both social and economic) of workers who head their own households appear to have a strong effect on the worker's likelihood to use such new facilities/opportunities. Further, occupational shifts as a result of new skill acquisition may appear too risky or remote a possibility for older workers to invest in such learning opportunities.

Job requirements – Among the various sub-groups within the staff, the housekeeping, maintenance and driving staff displayed a much higher propensity to use the PC than the security staff. This partly points to the constraints in place by workers' existing job requirements, which allow the usage of such services at the workplace to greater or lesser extents. The security guards, for example, follow a rigid work schedule and are required to stay in one location (posted at the gate) for the eight hours of their duty, with a defined break. The drivers on the other hand, enjoy a flexible and discontinuous (on-demand) work schedule, which allows them to locate themselves anywhere (at the PC) until they are called for a particular drop/pick-up job.

In all, tracking these initial patterns of usage confirms a set of findings from the literature (younger individuals more open to PC adoption than older individuals), while also contradicting others (those with existing PC skills more likely to use than those without). There seem to be a number of interactions

between key characteristics, including age, gender, baseline skill that result in higher or lower adoption. Moreover, the structural environment of each worker, including the requirements imposed on them in their regular jobs and lifestyles, seems to exert a significant influence in their ability to benefit from accessible and affordable IT in a shared usage scenario. Exploring these inter-dependencies will go a long way in helping unravel the complexities of IT adoption for desired socio-economic development outcomes.

B What kinds of PC usage emerge in the absence of formal structure and training?

This question relates both to the content of usage and the manner of usage, each of which involved a number of interesting observations.

Dominance of entertainment-related content – When it comes to preferred content, entertainment-related applications dominated usage in both offline and online modes. Browsing the Internet made up 50% of all application use, with local language film and music content contributing to almost a quarter of internet use. Games were the next most popular applications, with usage going from simple games that ship with the OS, to more complicated online games. There was at the same time, exploratory use of various other offline applications all the way from typing one's name and inserting an image using PowerPoint, to navigating through the Outlook set-up process entirely by accident. Use of the internet also involved varying experiences based on the user's previous PC exposure, with experienced users checking email on the PC. News portals, sports information, and examination results turned up as miscellaneous usages of the internet. While there were very few instances of actionable welfare-related information being accessed (e.g. job-search, English tutorials), separating "utility" vs. "ability" drivers of usage patterns over time in workers' specific contexts will be critical as the study moves forward.

Exploratory individual usage – Learning to navigate these various applications occurred through two distinct, yet complementary processes. On the one hand, given that access was free and accessibility continuous, individual users spent hours exploring various aspects of the PC, evidenced by the streams of random clicks and application launches by novice users. Often, the Internet was discovered through pop-ups in offline application usage (games or multimedia applications). The heavy use of "Help" (accessed thrice per day on average over the five week trial) was an encouraging sign that users were trying to teach themselves PC literacy, though the relevance and usefulness of the "Help" tool was often limited.

Active peer learning - On the other hand, group usage scenarios were key to the transfer of basic computer literacy from those who had had previous experience with using PCs to those who were beginners. This occurred in a step-wise fashion for many users. For instance, one of the housekeeping staff began by observing a group of drivers interact with the PC from a distance; he later returned with a colleague from the housekeeping division and observed him using the PC; finally he came on his own, touched the various components of the PC, and began using the mouse. It is interesting to note in this instance how learning was a function of not just interest and initiative, but also of social context and peer dynamics. Aside from observation, novices also directly approached more experienced users to understand how to access particular material, e.g. local language songs. Once YouTube was introduced to them by a technical staff worker, there was a sharp rise in YouTube hits on the PC. The rapid localization of various portals by experienced users (Google in Tamil in a week's time) also had a significant impact on novices' initial user experiences.

There are two key takeaways from the usage patterns observed so far. In shared usage scenarios, it appears that much of the learning depends on the interaction between the cumulative material accessed by various users. For instance, the browser history dropdown menu was used actively by novices to explore websites that their more experienced colleagues had found interesting. If this was a regular cyber café or rural shared PC kiosk where the browser history is cleared by a mediator between users (or the PC is brought to a uniform, clean, steady state), the transfer of knowledge between users through the PC would be lower. Similarly, the degree of personalization of the PC was surprisingly high, with the desktop background being changed almost at every session when a new user came to work on the PC. Not just limited to using existing images, the staff used this as a creative opportunity and often constructed complex backgrounds using the webcam, MS Paint, and other applications in the process. In many ways, the active personalization was also evidence of the degree to which time spent on the PC was valued, indicating a sense of ownership of the device. Encouraging such task-based and highly personalized user experiences in shared access scenarios will likely strike a positive chord with first-time users.

C Does such PC usage/ basic IT skill acquisition have any effect on workers' lives, livelihoods? In what ways does it affect the employer organization?

Measuring impact on economic welfare through changes in income or skill acquisition is a long-term goal, and five weeks does not provide sufficient time to see measurable changes in livelihood outcomes. However, we did observe some behavioral changes among the support staff after the introduction of the PC. The marginal increase in self-esteem scores recorded provides only a preliminary indication of what metrics might be relevant to a measurement of behavioral impact. That the staff self-reported having a more satisfying work-environment from the opportunity to access a PC and learn about new things when on the job was in itself a positive outcome. In some ways, this proximity to a fully accessible PC allowed for some of the conceptual mysticism surrounding the PC to be shed and a more realistic understanding of the PC to be formulated. Following this "instrumental good" aspect of IT adoption, particularly through more rigorous measurement of the "empowerment" effects of initially disenfranchised individuals, will be important to the study as we deconstruct how individual's confidence, self-esteem and opportunities are affected through their interaction with technology.

In the short-term, the value of this intervention to employers stems from the project leading to higher workplace satisfaction, employee development, and the fulfillment of corporate social responsibility objectives. More long-term, though, such a facility can be seen as boosting low-income workers' access to and adoption of technologies, thereby allowing companies to invest in digital literacy as a public good with long-term private returns. Our observations so far point to the employer being happy to provide this facility as long as there is no conflict with worker productivity. Towards this end, the use of the Office 'Hole-in-the-Wall' PC by the support staff has been encouraged only when workers are done with their official duty. However, given that much usage has been observed to be around entertainment, it will be important to understand how this correlates with worker productivity (enhancement or reduction). In a broader sense, we find that the office environment provides an enabling setting for low-income workers to acquire PC literacy, given the IT infrastructure that already exists in the facility (trouble-shooting and problem-solving becomes institutionalized), and given that the office is by default a space where people with varying skills congregate on a regular basis and share experiences. For

a marginal additional investment (a single extra PC and DSL line), if we establish a measured net positive social, behavioral and economic impact on the welfare of a company's support staff, this route may provide a powerful conduit to promote shared IT access and PC literacy to those in emerging market settings with limited access otherwise, in a systematic, supportive and sustained environment.

VI Limitations and Next Steps

The exploration described in this report showcases the first few weeks of a trial in which low-income workers employed as support staff at a corporate facility were given unrestricted access to a PC at their workplace. The initial dynamics of usage and patterns of use provide us with preliminary insights on how such interventions may be adopted in similar scenarios, and how PC usage in such interventions may or may not affect both the workers and the organizations involved. There is a palpable sense of pride and achievement among the workers in being able to overcome any pre-existing qualms to touch the PC, and even progress to playing simple games and browsing the internet on their own. The opportunity cost of investing in basic PC literacy has been dramatically reduced, given the convenience of having the device at an accessible spot at the office and given its 24/7 availability. Further, the absence of a monetary cost associated with PC access has allowed for extensive exploratory usage, more than the more task-based usage one might see in a pay-per-use cyber café/ internet kiosk scenario. The constant changes to the PC's display and settings indicate a sense of ownership, where care is taken to modify the desktop background and icon arrangements to suit a user's particular tastes, for the time that he uses the PC.

However, the experience so far raises more questions than it answers. While the PC's usage has consistently risen over the first five weeks, there is no indication whether this will continue to rise, or if it will peak at a certain point after which the novelty value of the PC will wear off and usage will fall. We are beginning to see some potential positive impact of the PC on worker morale and self-perception. However, what are the long-term effects of such basic computer skill acquisition? How might we separate "ability" from "utility" drivers of usage patterns? In the ideal case, longitudinal tracking would provide a strong panel dataset to analyse such questions. Yet, given the segment involved in the interventions, staff turnover and placement changes within the same job are frequent. This will require refinement in the study methodology to be able to allow for attrition, while still being able to measure unbiased impact on the average participant. On the flipside, from an organizational and employer perspective, what are the implications of a more "digitally inclusive" workplace for support staff welfare and retention? Will worker in-groups and out-groups re-form along lines of PC interaction, or will PC usage fall into the existing divisions between worker sub-groups that are job and gender-based? How will the tension between personal and shared usage of this common property resource play out? And finally, what lessons can we learn from the PC usage experiences of this adult computer novice audience in designing better computing interfaces and more relevant applications for emerging market customers?

A number of limitations need to be highlighted in assessing the relevance of these insights for a broader audience. There are likely a number of social and environmental pressures that inspire particular kinds of usage in this intervention. For instance, given that the PC was placed in a workplace, it is possible that workers had an incentive not to engage in job searches for fear of inviting management's displeasure in their current job. However, the widespread usage for entertainment without any fear of negative repercussions makes the possibility of self-regulated cautionary use in an office environment

somewhat less likely. On a different note, the office space in which our intervention was carried out was heavily male-dominated, which may make it difficult to generalize findings to more mixed or more women-dominated work spaces. Finally, the facility already was a support-staff-friendly workplace, even before the PC intervention, which may have independently influenced the positive self-perception and work environment ratings of the participants.

The time that has lapsed between the measurement of five weeks of usage and this write-up has itself witnessed further changes to the dynamics of the Office "Hole-in-the-Wall" intervention. The next phase of the intervention involves a more pro-active stance, where focus groups of users are held and their feedback is consolidated to design basic training exercises in particular key applications that are collectively selected as being of common interest. This will allow us to proceed from a simple device-based intervention to a more capability-based approach, where users' task and application goals are used as starting points for the intervention and the PC becomes a tool to achieve these desired outcomes. Our hope is that tracking usage, learning and impact in this augmented scenario will help us further understand the complex ways in which PCs are or can be enablers of improved human development.

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