A Cross-Market Taxonomy for ICT-in-Education Projects

Udai Singh Pawar (udaip@microsoft.com)
Microsoft Research India
Kentaro Toyama (kentoy@microsoft.com)
Microsoft Research India

Abstract

In recent years, there has been increasing effort in bringing computers to children's education in poor communities. After a series of site visits and literature review, we have proposed a taxonomy for computers-for-education projects that classifies them along two axes: learning goals and degree of adult supervision. Adult supervision can range from none at all (e.g., the "Hole in the Wall" project) to very controlled supervision (typical in many schools). In terms of learning goals, some computer classrooms are meant to teach the basics of computer usage and computer literacy (e.g., the first phase of the Akshaya project in Kerala); others provide supplementary material for augmenting the traditional school curriculum (e.g., CDs created by the Azim Premji Foundation); and yet others follow constructionist principles of learning that foster a mixed set of less tangible benefits such as self-confidence, empowerment, and problem solving ability (e.g., the Computer Clubhouse by MIT and Intel).

In comparing these computers-for-education projects across countries, our belief is that a straightforward application of developed-world learnings is not necessarily suitable for India, due to a variety of reasons. We can use the taxonomy mentioned above to gain added insight in understanding this problem. To begin with, learning goals can differ vastly across countries and even across demographics within a country. For instance, the needs and motivations of a school dropout in an inner city in America, are different from that of a school dropout in an Indian village, and this must reflect in their respective learning goals. Looking at the other axis, adult supervision is dependent on the availability of teachers. There is a severe shortage of qualified, willing teachers in rural
India, and even among them, not many may have the skills required to effectively integrate ICT in their schools. The technological implications of all these factors should be understood and kept in mind while designing projects and education initiatives.

**Introduction**

Computers-in-education has been a topic for almost as long as there have been computers. (For one historical overview, see Oppenheimer, 2003). The rapid progress of IT and particularly the Internet in recent years has led to an exponential rise in the amount of dialogue and work that is beginning to happen in this field, and in some ways the idea of ICT-in-Education has come of age. There are established journals and numerous conferences which bring together interested people from the diverse fields involved – computer science, education, design, and psychology. These people include more than just researchers – policy makers, industry persons, and even the media are taking great interest.

More recently, there has been more work that specifically addresses developing countries. There have been numerous projects around the world, from pilots that work with tens of students, to larger scaled experiments which reach out to thousands. In this paper, we begin to build a framework for understanding these projects (mainly for projects that address underserved communities), with the natural first step of trying to classify and compare them. We additionally seek new insights into what makes a project in a developing nation different from that in a developed nation.

**Proposed Taxonomy**

To gain a deeper insight into the various projects, we propose a taxonomy with two axes. The first axis refers to the project’s defined learning goals. These can range from ‘narrow’ computer literacy on one extreme to ‘broad’ human-development goals on the other. Goals of supporting fundamental education (e.g., reading, maths or literature) or
vocational skills (e.g., skills for agriculture) lie in between. A project may have goals that span multiple domains across this range.

The other axis is the degree of adult supervision. It can extend from having no teachers involved, to some teacher involvement (as in supervising the computer labs), to teachers involved as instructors. Teachers as mentors is an interesting case, as it is situational, and depending on the mentor and student, can span the whole spectrum, though generally here there is lesser intervention and more encouragement. We can take a look at Figure 1, which is a graphical representation of these ideas.

**Axis 1 - Learning Goals**

While studying a project, one aspect of primary interest is what the project intentions are in terms of learning goals, or takeaways for the learners. The Akshaya Project in Kerela for instance has focused on basic computer literacy through a network of telecentres. Other rural telecentre projects around the world and also in India such as Drishtee, n-Logue, also operate in this domain of basic computer literacy.

The motivation often quoted is with regard to the fact that IT is emerging as such an important factor in today’s global economy. This era is the information age, and it is crucial for the incoming workforce to be technologically fluent to be able to compete in this information economy, for their own benefit and for the state’s benefit. There is a lot of excitement surrounding the use of computers in general, as IT has indeed lead to great economic growth. Thus such projects are quite popular.

Other projects aim at using the same set of content as in the regular curriculum, working on the delivery side. This is popularly in the form of CDs that provide instruction on reading, science and basic mathematics, supporting that through simple quizzes and educational games. The Azim Premji Foundation, for example has built a set of CDs with educational content. A central idea in many such projects is of computer aided instruction, which has been around for a long time. Here, in some cases CDs have been
made in collaboration with the education authorities, or independently by content providers. Content based on the local curriculum, as well as a lot of imported content is available.

A different prescription is provided by some educators who feel that more than learning of knowledge from books, building the ability to create knowledge from experience and the skills to solve real world problems is far more important than the ‘rote-learning’ stereotypes of conventional education. Some of these constructionist educators advise that such skills are really the ones that will truly lead to better life outcomes. Rather than being constrained by what they have been taught in class, students can actively keep learning outside class. As job skills and requirements are not static, a student who can keep on learning will be able to deal better with changing situations and adapt accordingly. Other benefits described are building self-confidence, empowerment and problem solving skills. This extreme often consists of a diffuse and broad set of goals, as opposed to the very narrow focus of the computer literacy projects. The ‘human-development’ goals mentioned above refer broadly to these. The projects include Intel & MIT’s Computer Clubhouse (Resnick, 1998 & Hopkins, 2004), IIT Kanpur’s BRiCS (Mukherjee, 2002), and to an extent the Hole-in-the-wall project (Mitra, 2001 & Mitra, 2005). The Hole-in-the-wall project is interesting as it is located at both the ends of the scale, with computer literacy as an outcome, along with the above described set of more social or more human-development based outcomes.

**Axis 2 – Degree of Adult Supervision**

When we look at the projects from a different angle, one focusing on the teaching intervention aspect of the learning environment, some other observations come forth. We have referred to this as degree of adult supervision. First we look at the lower side. In the Akshaya project case as well as in others, we have observed that in many instances the teachers are so overworked that they do not take too much interest in what the students are doing with the computers. The students are left with the computer ‘taking care’ of them – the computer in some way takes up a babysitter role to keep the
students occupied. The Hole-in-the-Wall project is intentionally based on this idea of not having a teacher (or any adult) near the computer.

At the other extreme, even within the Akshaya project, we have seen cases where teachers are over careful and do not let the children touch the computers. In a lot of the schools which follow computer education curricula, teachers teach ‘by the book’, where step by step instruction are given for precisely defined tasks, which the students must finish according to the specifications.

Some of the constructionistic projects, such as the Computer Clubhouse, and IIT Kanpur’s BRiCS are based on the ideas of mentors – which can even be college-going volunteers, local artists, or older students. The mentors do not engage in instruction per se, but try to guide and enable the students to explore and learn. This can be by discussion, motivation and in few cases actually some hand holding.

The Digital Study Hall (Wang, 2004), a project in the city of Lucknow, UP, takes a deeper look at the teacher problem. Student teacher ratios in rural schools can reach up to 100:1. Even the teachers present are often not up to the mark, especially in English and Science. This project is evolving a form of distance education where the postal system is to be used as a medium for the delivery of video lectures. These are recorded in the classrooms of highly regarded urban teachers, and played back in the village, mediated by a local teacher, who pauses the video at appropriate times to encourage discussion, thus facilitating the lecture delivery. The model proposes that like a mentor, the facilitator need not be an expert, just someone who can instigate interaction.

**Issues not considered**

Before we go further, it is important to understand what this taxonomy does not address and why. In discussions of ICT for development projects, the technology itself often takes centre stage. We will ignore this component in our framework if only because technology deployment has been a prime topic for discussion and all debates of
economics and feasibility follow from that. In simple terms, one has to provide a computing device, and connectivity. While we realize that technology access itself is a highly crucial deciding factor that will determine the eventual possibility and scalability of ICT-in-education projects, we will not consider technology in this paper for two reasons. First, it can be easily seen that this is already a major component of the literature on implementing ICT projects in developing nations (for example see Hawkins 2002; HDN, World Bank 2002; Kam et al 2005; Osin 1998 etc.) There are various important problems such as climate, remote maintenance, power availability, policy, etc. of relevance in setting up technology in what are often difficult environments. But we want to try to look beyond what constitute the access problem, and see what the others problems are are.

Secondly, we notice that the least common denominator or baseline for technology across projects is a standard desktop PC with an internet connection. Projects providing this to villages are being launched on a regular basis, with almost a similar setup across them. But we also note that in some cases the whole domain of discussion becomes the technical and economic, without really looking into exactly what role the same computer will play in the education scenario. This may result in situations where past the initial excitement, not much comes out of the project in term of tangible returns, or we may find situations where the PCs are not being used as desired or at all. (e.g. as mentioned in Duflo, 2003). So for the purpose of this discussion, we take the technology variable as a given, and focus on more of the pedagogic dimensions.

Comparison with other schemes

We can compare this framework to some other taxonomies for ICT-in-education. The first, a work of Mioduser et al. (2003) looks at understanding the assimilation of ICT projects in 10 schools in Israel and studies them along two axes – level of innovation, from assimilation to transformation; and domain of innovation (teachers’ roles, students roles’, curriculum, etc). This in some ways studies a system response, to understand
how the project is being integrated within the education system. It affords a look into understanding the acceptance and implementation of the innovation provided by ICT.

The second work of Jedeskog and Nissen (2004) categorises the ways of working with ICT. It exists in a sub-space with more of a focus on the basic building blocks of the learning experience such as the learner’s assignments. One axis is task objectives, and the other is task methods. Both range from teacher-directed to learner-centered. The author’s schema of the four quadrants is useful for understanding – “Do this in this way” is a teacher-directed task objective and teacher-directed method, while “Do anything in anyway” is a learner-directed task and method, while the intermediate quadrants are “Do this in any way” and “Do anything in this way”.

Both of these are relevant for understanding ICT-in-education practices. The first provides a framework to understand scalability, acceptance and deployment on the macro scale, while the second looks as the actual learning experience in the micro scale – a detailed look at the teacher/student roles.

The new taxonomy described in this paper is beneficial as it is somewhat more tangible in terms of observables and variables, which rather than being purely in the micro and macro scale, are at the interface. The learning goals can be understood and stated as objectives, and can be directly evolved from the real learning needs – these goals can be broken down to actual micro tasks. At the same time, the learning goals also define the degree of innovation and societal response. The other axis, also depends on the very real situation with regard to teachers, who have to deal with the innovation from the first viewpoint, and also implement the tasks from the second. Our taxonomy is meant to be more centrally located from a pragmatic design based perspective. It can be a generalized starting point before one can take a more particularized perspective with the other taxonomies.

**Developed versus Developing Countries**
We believe that our taxonomy is useful in understanding the differences that exist between developing and developed countries in context of ICT-for-education projects.

The basic intuition is that learning goals need to be drastically different across developed and developing countries. A primary driver for this is the entry level job that a learner has access to. The major occupation in Indian villages is agriculture. On migration to a city, a low income villager would start at jobs such as a driver or a peon if he’s lucky, but more often as a construction worker or petty labourer, for which computer literacy often seems irrelevant. Of course, fluency with technology may help people with certain city jobs or with the local rural telecenter project. But, this would impact only a negligible percentage of the people in these economic segments. The situation is quite different in the west, where indeed many lower income people can take up entry level jobs that require IT skills.

Another aspect comes up when we try to look horizontally across countries, moving through the same demographic slabs - of ‘rural’ or ‘underserved’. There is a world of difference when we shift from developed to developing countries, which shows up in the sharp contrast of social context, even for similarly pegged income ranges. An example of the disparity in social context can be seen by comparing student attrition. Poverty is so profoundly debilitating in some Indian villages, that parents, even those who fervently wish to send their children to school, might not be able to afford to do so (Krishna, 2004), because of the opportunity cost of child labour. The case studies of dropouts from underserved communities in the west that some ICT-in-education projects deal with paint a very different picture (Resnick 1998) Students drop out because of lack of interest in school. Often their parents are happy that they are involved in an ICT project even if it only means that their children are not getting into any bad company.

Another comparison that can be made is about the baseline literacy level when we compare across the countries. In India, there is a large percentage of people who cannot even sign their own name or do basic calculations. In this context, a better investment may be to make basic literacy a more explicitly defined aim, staying with
‘narrow’ educational goals but changing the direction from computer literacy to basic literacy. There are some CDs available for learning the basic ‘three R’s – Reading, Writing and Arithmetic. Some people have criticized these in western contexts (Oppenheimer, 2003), but in some ways these are more relevant than computer literacy programs – as these do address immediately tangible needs.

The other major comparison across developing and developed countries happens at the second axis of adult supervision. The number of schools and teachers at the rural level is too low to support the number of children of school going age. Where schools do exist, student teacher ratios are very high. There is also the problem with regard to teacher training and abilities. Though the salaries are not very bad, the good teachers prefer to stay in the cities and towns rather than go to out of the way villages. Additionally, with regard to projects that are based on mentorship, a question that arises, is that in situations where it is difficult to find even the teachers for standard behavioristic, instruction based learning, it may be much harder to find people suitable for mentoring and to train them accordingly.

To add some complexity, even in western countries with highly qualified teachers, ICT projects have faced resistance to change at one level, and inability to integrate ICT into the curriculum at other levels. This problem can be exacerbated in rural villages in India, given the fact that though most western teachers will have some exposure to computers, Indian village teachers may have never seen one. Thus how the project design thinks about the role of the teacher is very important.

**Conclusion**

We believe that there are major considerations that when trying to compare implementations of ICT-for-education projects between developed and developing countries. We have constructed a taxonomy to take a deeper look into it, exploring the two dimensions of learning goals and degree of adult supervision. Here we are not looking at the technology or access question, as we believe that there is a need to look
beyond just the aspect of hardware and economic feasibility and try to see that given that, what should be done on the learning methodology front. Secondly, while trying to study projects in developing nations and understanding their portability to developing countries like India, one should realize that there are issues to address at a far deeper level than just access, such as local context, variable educational needs and human capital such as teachers.

Taking a deeper look, the biggest technological interventions need to come at the level of content and micro level content delivery. We have discussed the issues that need to be considered above. Our belief is that this approach is bottoms up, where the local needs and contexts are to be understood first before designing the delivery methodology, the technology and finally the economic model, rather than the top down approach of deciding a technology to implement and only searching for applications later.

References


Duflo, E. et al. (2003), “Remedying Education: Evidence from Two Randomized Experiments in India,” Mimeo, MIT.


Figure 1. We can see the two axes topology, with some projects located on it.