EXPLORING ONE-TO-ONE COMPUTING ON THE GROUND: THE "100-DOLLAR" LAPTOP AS A LEARNING TOOL FOR SOCIALLY DISADVANTAGED SCHOOL CHILDREN IN INDIA

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ABSTRACT

In recent years, there has been an influx of single-user laptop projects in educational settings. The rationales are to address purported access gaps, foster student-led learning, and encourage the development of 21st century digital literacies. More recently, low-cost laptops are being distributed in developing country contexts, with the goal of providing children with new educational opportunities. However, technologies are being distributed even before the socioeconomic and cultural contexts of their use are fully understood. This work aimed to study one implementation of the One Laptop Per Child (OLPC) initiative in a South Indian city. A naturalistic case study methodology was adopted to explore how the program manifested in a school for below-poverty-line children. The findings revealed that social, cultural, economic, and curricular considerations both enabled and constrained the program in many ways. This suggests that an understanding of the social-embeddedness of technology is vital to the success of such programs.

Keywords: one-to-one computing; low-cost computing in developing countries; laptops in schools; computers in the classroom; laptops for education; 1:1 student to computer ratio; One Laptop Per Child; OLPC; XO laptop; 100-dollar laptop; educational technology and socioeconomic factors; low-cost laptops in India; digital divide

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CHAPTER 1 — INTRODUCTION

The use of the personal computer in schools has been at the core of many debates about classroom learning, and has been both advocated (Allen, 2003; Johnson, 2003; Resnick, 2002) and challenged (Armstrong & Casement, 2000; Cuban, 1993; Cuban, 2001; Oppenheimer, 1997). The computer has been viewed contrastingly by scholars as "the dream machine" that can enable creative, transformative everyday learning experiences (Johnson, 2003) and the "silicon snake oil" that can only foster inauthentic, artificial experiences detached from real life (Stoll, 1996). Considerable efforts have been made in the education community to better understand how computers can be used by students and educators, what value they offer, and what systemic factors surround their integration (eg. Cuban, 1986; Warschauer, Knobel, & Stone, 2004; Zucker & McGhee, 2005). Yet, empirical research has provided a mixed picture about what value these technologies have contributed to educational systems and practices, which some argue is due to the contrasting ideologies around computer use (Willis, 2003; Willis, Jost, & Nilakanta, 2008).

Even as thinking around the use of computers is evolving, new computing programs are making rapid inroads into schools worldwide, both in developed and developing countries (Kearns, 2002; Windschitl & Sahl, 2002; Pawar, Pal, & Tomaya, 2006). Governments and schools are investing more than ever before on technology with the goal of bringing the latest in computing developments to children. For instance, in 2004, the United States budgeted more than 690 million dollars in block grants to be invested in educational technology (Kozma, 2005).

The speed and volume of the development and diffusion of computers and digital technologies is making it ever more difficult to develop an integrative understanding of the value proposition of computers in education. The proliferation of newer models of computing (eg. stationary desktops versus mobile laptops or handhelds, shared versus single use) and the very different contexts of computer use (eg. developing versus

developed countries, poor school districts versus affluent ones, elementary school versus high school) further complicate this issue. Becker's (1998) metaphor of "running to catch a moving train" (p. 20) seems an apt description of the current catch-up-keep-up scenario being witnessed due to rapidly evolving trends in educational computing.

One particular computing trend that has gained popularity in recent years is the idea of providing children with a computer of their own. Extending the idea of simply making computers available to children, children's level of access to computers is operationalized as a student to computer ratio (Pelgrum, 2001), which is taken to be the ratio of the total number of students in an educational setting to the total number of available computers for those students. In the years spanning 1983 to 1998, the student to computer ratios in K-12 schools fell from 168:1 to 6:1 (Anderson & Ronnkvist, 1998). In Canada, the United Kingdom, and the United States, student to computer ratios below 10:1 have become common in schools (Hepp, Hinostroza, Laval, & Rehbein, 2004), and as of 2005, the estimated ratio was 3.8:1 (Warschauer, 2007, citing Market Data Retrieval, 2005). Governments and schools are striving for ever-decreasing student to computer ratios, many with the goal of providing children with 1:1 access to computers. In developing countries as well, where resources are far more limited, attempts are being made to reduce student to computer ratios by exploring initiatives such as students using multiple mice connected to the same PC (Pawar, Pal, & Tomaya, 2006) or virtual desktops running multiple work terminals connected to a single computer (Prasad, 2008; Patra, Pal, Nedevschi, Plauche, & Pawar, 2007).

The label "one-to-one computing" is being increasingly used to refer to such a computing model where the ratio of students to computers is 1:1 (eg. Penuel, 2006; Warschauer, 2006; Zucker & McGhee, 2005). However, even with a 1:1 ratio, other factors contribute to determining students' level of access to technology, including frequency of use (i.e., the number of usage hours per week) and location of use (e.g., school and home versus school only, computer lab in school versus classroom). For instance, Figure 1 is an attempt to illustrate how even with 1:1 access to computers, the nature of computer usage can vary across other dimensions.

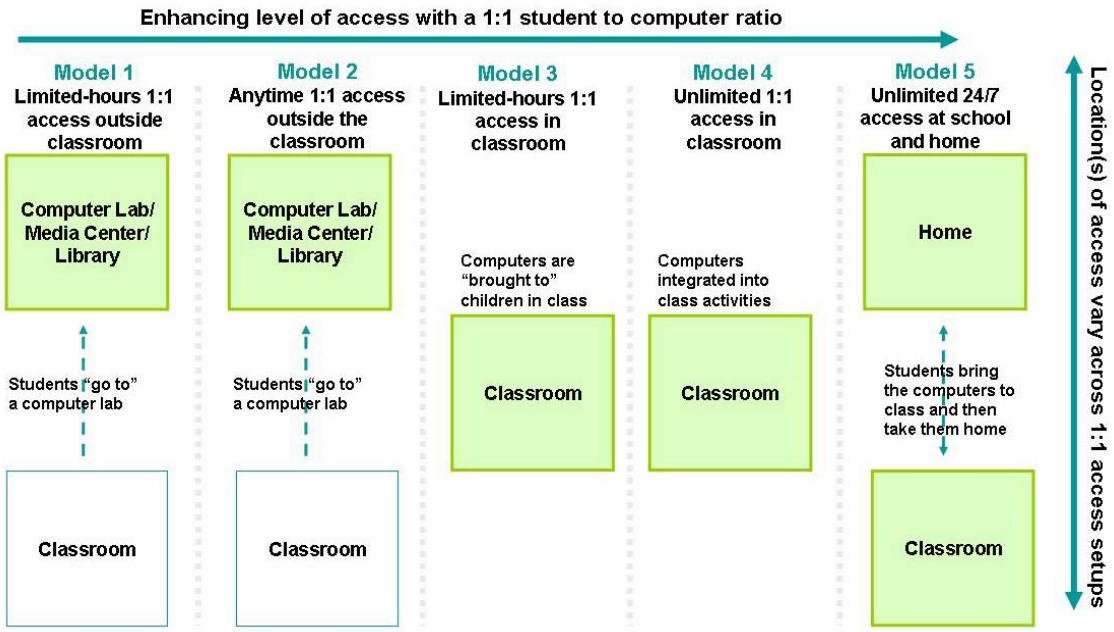


Figure 1 - Different Computing Models based on 1:1 Access to Computers

Due to the varied ways in which one-to-one computing can be implemented, it is recognized that a commonly accepted definition of this computing model is yet in the making. It is variously taken to refer to high access computing, unlimited access to computers or laptops at school and at home, or simply a student to computer ratio of 1:1 (Bielefeldt, 2006). Penuel (2006) offers a more specific definition, describing it as having three main characteristics:

> (1) providing students with use of portable laptop computers loaded with contemporary productivity software (e.g., word processing tools, spreadsheet tools etc.), (2) enabling students to access the Internet through schools' wireless networks, and (3) a focus on using laptops to help complete academic tasks such as homework assignments, tests, and presentations (p. 331).

Penuel's (2006) definition presupposes Model 5 shown in Figure 1 above. This study is grounded in Penuel's definition of one-to-one computing for two reasons: one, because it defines specific boundaries for this new model of educational computing where students are able to integrate computers into most aspects of their daily life; and two, because it represents the model of one-to-one computing that many makers of low cost computers targeting developing countries are striving to achieve. In terms of the

terminology, throughout this study, when I refer to 1:1 access, I am referring exclusively to the ratio of students to computers. When I refer to one-to-one computing[1], I am referring to Model 5 as illustrated in Figure 1, which aligns with Penuel's definition.

Researchers see great potential for one-to-one computing to be used in schools, particularly since it offers the potential to seamlessly bridge students' use of technology at home with what they use at school (eg. Grimes & Warschauer, in press). But for this model to be feasible in reality will involve the availability of adequate funds and resources, systemic and pedagogical changes from prior computing models to truly integrate computing into school and home activities, and the redefinition of traditional assessment schemes within the educational system (eg. Dwyer, Ringstaff, & Sandholtz, 1994). Currently, we do not have a broad enough empirical picture of how one-to-one computing translates on the ground in different contexts or the value of such a model. Empirical study would help to ascertain whether one-to-one computing as Penuel defines it actually translates into daily use when confronted by the "situationally constrained choices" (Cuban, 1986, p. 66) within a school context. As well, we need to understand the attitudes and expectations of various stakeholders involved in the implementation of such a program including administrators, teachers, children, and any third-party individuals or agencies associated with the implementation.

All the situational factors confounding the translation of one-to-one computing on the ground are even more uncertain in the context of developing countries, where there have been various drives to introduce low-cost one-to-one computing to low-income learners and an inflow of low-cost computers and laptops to make this possible (Patra, Pal, Nedevschi, Plauce, & Pawar, 2007; Gaudin, 2008; Poeter, 2008; Nystedt, 2008).

The limited understanding of one-to-one computing in developing countries combined with the current trend of laptop donation programs in these countries was a primary motivator for this thesis work. The focus was to study a developing country context to explore how the vision for one-to-one computing translates into everyday

[1] One-to-one computing as defined here must be distinguished from the concept of ubiquitous computing. The latter refers to learning environments where a variety of technologies and services are available to learners at all times, a scenario that van 't Hooft, Swan, & Cook (2006) refer to as many-to-many as opposed to one-to-one.

execution. In Chapter 2, I describe the background factors leading up to the current trend of one-to-one computing in developed and developing countries along two key dimensions: first, the equity issues surrounding access to computers including the common more-begets-more assumption that predicates high-access and one-to-one computing; and second, the pedagogical evolution of computing in schools that has led to the current leaning toward one-to-one computing. Drawing on previous research in educational computing (particularly one-to-one computing), I will lay out the justification for this work: the lack of empirical studies of one-to-one computing for education in developing country contexts.

In Chapter 3, I detail the macro context of this study, namely the One Laptop Per Child (OLPC) initiative that has deployed batches of its "100-dollar" laptops to various developing countries. The distribution of OLPC laptops to schools in India has received public attention since the Ministry of Human Resource Development in India rejected the proposal to adopt the OLPC laptops on a mass scale in favour of addressing the basic education and literacy goals of the country (Chishti, 2006). Despite this choice by the government, non-governmental organizations and private enterprises in India have coordinated with the OLPC to arrange laptop deployments in various Indian schools presumably seeing value in a low-cost one-to-one computing setup. One such deployment is at a non-profit school for socially disadvantaged children in a Southern Indian city. The laptop program at this school including the stakeholders and activities associated with the program are the micro context of this work. Chapter 3 also describes the theoretical perspective underlying this study, which is a lens to understand the social and systemic factors surrounding the integration of OLPC laptops in the selected micro context. Chapter 3 concludes by presenting the purpose of this work and the specific research questions asked.

Chapter 4 explains the choice of the case study methodology, which was adopted to provide a rich exploration of the context, taking into account both social factors and the viewpoints of multiple participants. I continue by explaining the choice of the site and participants, as well as the data collection and analysis procedures. In Chapter 5, I "reconstruct the field" as an attempt to create a glimpse of the site as I experienced it. I use two approaches to do this: the first involves a written description of the school

environment, and the second involves the use of short episodes to depict lived experience with the laptops. Chapter 6 presents the findings of this work, reported in relation to the research questions asked and the themes that emerged from the process of data analysis. In presenting the findings, the focus was to retain as much of the participants' voices as possible to present the everyday experiences and issues with the laptop program from their perspectives. Chapter 7 discusses the implications of the findings for one-to-one computing, highlighting the "growing pains" faced from both the equity and pedagogical perspectives. The chapter concludes by discussing the limitations of this work as well as directions for future study in one-to-one computing.

CHAPTER 2 — BACKGROUND: ONE-TO-ONE COMPUTING IN SCHOOLS

A diverse set of rationales underlie decisions to introduce computing to children in educational settings. Most often, these fall into two categories: the *digital equity* rationales and the *learning and pedagogy* rationales. This section describes the goals and assumptions underlying each of these rationales, outlining how each has naturally culminated in the idea of one-to-one computing for education.

Computers for Children: The Digital Equity Rationales

The unequal access to information technologies across communities and regions is often referred to as the "digital divide" (Warren, 2007; Cullen, 2001; Tiene, 2002). Popularized in the late 1990s, the term refers to the "perceived gap between those who have access to the latest information technologies and those who do not" (Compaine, 2001, p. xi). The lack of access to these technologies is thought to have created an *access* gap (in the form of "have" and "have-nots") and in turn, a *knowledge* gap (in the form of "know" and "know-nots") (United Nations Development Program Report, 1999, p. 57; Kozma, McGhee, Quellmalz, & Zalles, 2004).

In past years, a compelling justification for providing computers in schools has focused on the issue of equity and equal opportunity (Wiburg, 2003). In particular, this rationale for computer use involves addressing the technology access gap between learners from different socioeconomic backgrounds (Sutton, 1991; Warschauer, Knobel, & Stone, 2004). Many argue that providing the ability for children from disadvantaged backgrounds to learn and use computers in schools gives them an equal footing to participate and compete equally in a society that is increasingly technology-equipped and driven (Becker, 2000b; Novak & Hoffman, 1998; Martinez, 1999).

> Digital equity is the latest battle in the effort to keep access to education and political representation open to all-to avoid having a technological underclass that contributes to the economic and educational divides that

> already exist. Educational access in its deepest sense is about the right to learn and to know and the right to an education. It is about who has a right to know and who decides what is important to know. Further, in a digital age it requires understanding the changing nature of how one comes to know (Wiburg, 2003).

In developing countries, the justifications for using computers have focused on how they can support development along many dimensions. Using computers in educational contexts is seen as a way to enable participation and competitiveness in global communities (Osin, 1998), compensate for common problems with the education system such as low numbers of teachers or qualified teachers (Glewwe & Kremer, 2006), and support both literacy training and subject learning (Grace & Kenny, 2003). It is believed that access to and the use of Information and Communication Technologies (ICTs) such as computers can have implications for people's level of access to information, the ability to connect with others, and the development of knowledge (Selwyn, 2002). In many countries (both developed and developing), the diffusion of ICTs has been positively linked with country-level economic development indicators including Gross Domestic Product (GDP) growth, the development of labour skills, the creation of new employment opportunities, the creation of new businesses, and higher productivity gains (López-Bassols, 2002; Baliamoune-Lutz, 2003; Kozma, 2005; Steinmueller, 2007; Draca, Sadun, & Van Reenen, 2007; Pilat, 2004; Maldonado, Pogrebnyakov, & van Gorp, 2006). ICTs are also linked with Individual economic benefits such as the development of skills, enhanced productivity, and increased earning power (eg. Pilat & Wölfl, 2004).

Unequal Access to Educational Computing: An Access Gap or More?

Unequal access is both a social and ethical issue, and its implications are complex. In general, the inadequate access to information and communication mechanisms in a society or community (also called "digital poverty" [Barrantes, 2007]) is believed to precipitate "information poverty" (eg. Barja & Sören-Gigler, 2007). In fact, some consider the digital divide as more than just a technological gap, arguing that digital exclusion can itself represent a form of social exclusion (Servon, 2002; Cullen, 2001; Warren, 2002). For instance, Norris (2002) conceives of the digital divide as a

"multidimensional phenomenon" (p. 4) with three underlying aspects: a *global divide* in access to the Internet between developed and developing nations, a *social divide* in the degree of information available to people within countries, and a *democratic divide* between those who use and do not use digital technologies to "engage, mobilize, and participate in public life" (p. 4). From these characterizations, it is clear that the digital divide is a complex and multilayered construct. The fundamental binary of "having" or "not having" access to technology is thought to initiate a domino effect into other aspects of individuals' lives and their ability to participate in society.

A contrary perspective claims that the digital divide is needlessly portrayed as a "crisis", and that inequalities in access to digital technology are not really a problem since "have nots" might actually be "want nots" (Brady, 2000). This position claims that other inequalities such as lack of minimum needs (eg. food, healthcare, epidemic control) are the real problems that warrant attention and efforts (see Brady, 2000; Akpan, 2005; Lei, Conway, & Zhao, 2008). This is reminiscent of Bill Gates' comment that for the poor making less than 1 dollar a day, ICT are an unaffordable luxury rather than a basic necessity (McNamara, 2003). In this view, technology access is likened to simplistic material acquisition/distribution such as the ownership of goods like video games (Brady, 2000).

In both the preceding positions, the "moral significance" of the digital divide in terms of social justness and ethicality is an underlying area of disagreement (Rooksby & Weckert, 2004). Rooksby & Weckert (2004) take a more practical stance to the moral significance of digital divides, pointing out that they are "morally objectionable to the extent that they create, perpetuate or exacerbate morally objectionable conditions of other sorts, such as material deprivation, or abridgement of liberty" (p. 29). Turning their position over to the positive, could ICT not be looked upon as morally *desirable* to the extent that they create or foster morally *desirable* conditions, such as socioeconomic progress, social inclusion, the development of knowledge, and enhanced participation within communities? After all, if a core goal of development is to work to overcome "deprivation, destitution, and oppression" (p. xi) and eliminate peoples' "unfreedoms" (p. xii) (Sen, 1999), then it is more productive to adopt a critical yet balanced view of any

intervention that has the potential to support development, such as information technology. Outright rejection is just as problematic as outright acceptance.

One way to keep quick judgment out of technology evaluations is to look specifically at access issues but also beyond access itself and to the value of introducing and using technology in terms of its functions and functional benefits. Papert (1987) notably pointed out the risks of the opposing "technocentric" and "humanistic" arguments around educational technology in schools, with their strong pro and anti stances respectively. Instead, he called for critical thinking around computers to better understand their role in education and culture.

> The purpose of computer criticism is not to condemn but to understand, to explicate, to place in perspective. Of course, understanding does not exclude harsh (perhaps even captious) judgment. The result of understanding may well be to debunk. But critical judgment may also open our eyes to previously unnoticed virtue (Papert, 1987, p. 22).

Kay (1972) also presented a compelling argument for his proposed DynaBook computer, which he declared was not necessarily the answer to the world's problems but could be a gateway to new, creative ways of meaning-making:

> This new medium will not 'save the world' from disaster. Just as with the book, it brings a new set of horizons and a new set of problems. The book did, however, allow centuries of human knowledge to be encapsulated and transmitted to everybody; perhaps an active medium can also convey some of the excitement of thought and creation (Kay, 1976, p. 1).

While it is acknowledged that access to technology can either "alleviate or exacerbate existing inequalities" (Warschauer, Knobel, & Stone, 2004, p. 563) such as academic achievement gaps, gender inequities, or social inequities, many have looked at its potential to bridge those gaps. For instance, particular attention has been paid to address the differing levels of access to technology across neighbourhoods, regions, or population demographics (for instance, the degree of access in schools in poorer districts versus those in more affluent ones, childrens' unequal access to home computers, or racial and gender differences in access to computers) [eg. Sutton, 1991; Jenson, de Castell, & Bryson, 2003]. According to Hurn (1993), in the United States, "schools have long been seen as a great equalizer, as perhaps the single most important institution that

works to erase the handicaps of birth and create a society truly open to the talented" (p. 102). Hurn's viewpoint calls for equal opportunity (whether in access to education, quality of education, or the use of computers) to fail or succeed based on individual capabilities and efforts.

Conceptualizing Models of Access to Educational Computing

Access is usually taken to be the opportunity to use one or more computers. Katz & Rice (2002) offer a useful way to conceptualize access as not just the opportunity to use computers (and the Internet) but also the knowledge of what to do with them once they are available.

> We define *access* in a minimal way. If a person with (or without) effort can have access to a networked computer and is able to use that networked computer to find material (such as webpages) or to communicate with others (such as through e-mail), then that person has access to the Internet. Having knowledge of what is there with no means of obtaining it or having technology but no knowledge of how to use it does not constitute access (Katz & Rice, 2002, p. 4).

Purely at the technological level, there have been two ways of conceptualizing the different levels of access to computers and the Internet: first, as a have/do not have binary; and second, as a continuum of low to high to unlimited levels of access (based variously on student to computer ratios, frequency of use, and the integration of use with daily activities). The former conceptualization seems to indicate a bipolar split between having and not having in terms of technology access, whereas actual access patterns are more usefully conceptualized as a continuum (eg. Warschauer, 2003). In Figure 2, I show how different access models can be conceptualized along a broad continuum. The figure indicates how low-access, high-access, and one-to-one computing could look like in terms of student to computer ratios, frequency of use, and integration of home-school use. As we progress from low-access to one-to-one computing (from left to right in the diagram), we see an enhanced integration of computers into students' daily life and activities. On the other hand, in low-access models, students only use computers for limited hours in schools in a shared context.

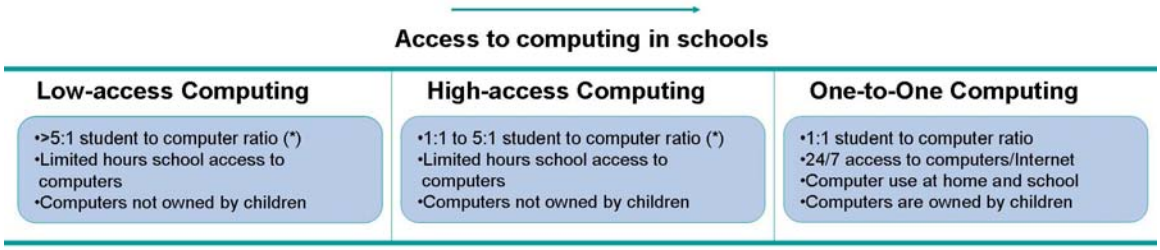


Figure 2 - Conceptualizing Levels of Access to Computing

The student to computer ratio range allocated as high access in Figure 2 is based on the average ratios observed in the United States and Canada in recent years. For instance, the national student to computer ratio in the US was 3.8:1 in 2005 (Boston Indicators Project, 2006) and the median ratio of students per computer was 5:1 in Canada in the academic year 2003-2004 (Human Resources and Skills Development Canada, 2005). The reason for selecting 1:1 to 5:1 as the range for high access is because it represents the current highest access ratios seen worldwide (after the United States and Canada, Japan comes in at 5.3:1 as of 2003) [Human Resources and Skills Development Canada, 2005]. Any scenario where more than five students share a computer could be considered low-access, and of course, depending on context, there can be several levels of low access (for instance, ratios from the tens to the hundreds). The reason for including 1:1 access not only in the unlimited access model but also in the high-access model, is to capture cases where 1:1 access is observed but is only implemented for limited frequencies of use rather than fully integrated round the clock with students' school-home activity cycle. The key goal in developing the access model conceptualization (Figure 2) is to illustrate how one-to-one computing as Penuel (2006) defines it is not only simply a "high access" model of computing, but a model that assumes access to laptops is available at all times and all spaces children inhabit, and further, is integrated with in-school and out-of-school learning activities.

Similar to the culmination of high-access computing in one-to-one computing, the pedagogical thinking associated with computers in schools has also seemed to evolve towards the idea of one-to-one computing. Scholars and educational practitioners have been looking for ways in which technology can be used to place the control for learning in the hands of learners themselves while at the same time expand access to computers,

preferably to unlimited 24/7 access. The idea is that with this greater exposure, computer use will become a natural part of students' daily activities, encouraging a further development of digital literacies (beyond simply knowing how to operate and use computers) [eg. Eshet-Alkalai, 2004; Aviram & Eshet-Alkalai, 2006]. The next section traces the learning and pedagogical rationales associated with various models of computing, showing the shifts in thinking that have made one-to-one computing possible.

Computers for Children: The Learning and Pedagogical Rationales

Scholars in educational technology have been following the use of technology in classrooms over several decades. Explorations of technology use in schools broadly span two eras: pre-computing, when radio, television, and video entered classrooms, and post-computing from the late 1950s when computing machines and computers started to be used. In the pre-computing era, discussions around classroom technology were optimistic about the use of film and television, often a throwback to Thomas Edison's famous proclamation that the motion picture would replace textbooks in schools (Cuban, 1986; Rosenberg, 2000). Technology itself was attributed with a transformative ability by those hoping to reform educational practices.

In tracing the history of educational computing, we can see that computers have been intended to serve very different functions in schools over the years. The role of computers in education has also evolved side by side with epistemic assumptions about learning and education. For instance, the earliest function of computers in schools was simply to enhance the efficiency of "delivering" knowledge to learners. An example of this was B.F. Skinner's machines for programmed instruction in the behaviorist tradition which entered schools in the late 1950s (Skinner, 1958). These machines were followed by Don Bitzer's machine for computer-assisted instruction called "Programmed Logic for Automatic Teaching Operations" (PLATO), a self-paced drill and practice tutor for students. In this phase of educational computing, computers seem to have served two distinct roles: first, as a productivity tool for teachers to effectively delivery instruction, and second, as a novel way to provide instructional variety for learners much like television and film before. The terms "teaching machines" (Warschauer, 2006) and

computer-controlled "teaching systems" (Bitzer, 1976) are often used to refer to the role of computers in this early phase of educational use.

By the late 1970s, a philosophical change started to occur in relation to educational computing. This was the shift from the idea of computers as teaching machines or efficiency tools to that of computers as "creativity" tools to promote learner inventiveness (eg. Schifter, 2008). This shift purported an enhanced learner *agency* or *control*, where the focus was for learners to take a more active, constructive role in using computing tools rather than being passively tutored by a drill and practice machine. Some of the best known educational computing tools were the outcome of this philosophy including Papert's (1992) LOGO programming language, Kay's (1972) prototype of a notebook computer for children called the DynaBook, and Jonassen's (1996) mind tools.

Papert's description of the shift from "instructionism" to "constructionism" (p. 142) best captures the ideological evolution from the early teaching machines to the new active learning tools. Whereas instructionism hinged on improving instruction, constructionism focuses on children developing the knowledge required in a context by themselves, and being supported in the process of their efforts.

> Constructionism also has the connotation of 'construction set', starting with sets in the literal sense, such as Lego, and extending to include programming languages considered as 'sets' from which programs can be made, and kitchens as 'sets' with which not only cakes but recipes and forms of mathematics-in-use are constructed. One of my central mathetic tenets is that the construction that takes place 'in the head' often happens felicitously when it is supported by construction of a more public sort 'in the world' – a sand castle or a cake, a Lego house or a corporation, a computer program, a poem, or a theory of the universe. Part of what I mean by 'in the world' is that the product can be shown, discussed, examined, probed, and admired. It is out there (Papert, 1992, p. 142).

Both Papert and Kay drew from and extended Dewey's active learning and Piaget's constructivism (see Papert, 1993; van 't Hooft, Swan, Cook, & Lin, 2006) to think about how children learn with educational technology and what kinds of technology best support the process of knowledge construction. Appropriate educational technology from a constructionist perspective then becomes the tools that support the process of learners constructing meaningful understandings relevant to the world around them.

In the early 1970s, Kay (1972) proposed the DynaBook computer for children, which was intended to allow for both reflexive self communication and social interaction with others. Kay called it a "personal computer" (p.3) (he is credited for coining the term), to refer to the fact that it would be owned by its user and be portable. Kay's description of the proposed DynaBook computer took into account descriptions of the graphical user display, keyboard, file storage, processor and storage, size, and costs, which at the time he estimated would sell at $500, an admittedly high figure. Despite its potential, the DynaBook did not successfully get built, due to the associated costs. Yet, it is often called a vision way ahead of its time (Löwgren & Stolterman, 2004).

Other educational computing tools that drew from constructivism include "mind tools" or computer programs that function as cognitive tools to help students think meaningfully by embedding the learning problem in the computer task. The learning philosophy behind mind tools was again, to promote active, constructive learning. Papert's constructionism and Norman's (1993) idea of higher-level reflective thinking as opposed to lower-level experiential thinking were also cited as important influences behind mind tools (Jonassen, 1996). According to Jonassen, a wide variety of educational "mind tools" can support critical thinking including spreadsheets, mind mapping tools, expert systems, computer-mediated communication (CMC) tools, multimedia, computer programming, and immersive environments. Thus, Jonassen, like Papert and Kay, looks at computers as offering a variety of capabilities or tools to support active knowledge construction.

Over the past decades, the learning rationales associated with the introduction of computers include: enabling more efficient classroom or subject area instruction (Collis & Sakamoto, 1996; Rieber & Hannafin, 1988), improving teaching practices (Becker, 2000a; Hawkridge, 1996), improving student achievement or learning outcomes (Banerjee, Cole, Duflo, & Linden, 2007; Becker, 1998; Hokanson & Hooper, 2000), and fostering process-oriented learning approaches (Jonassen, 1996; Kay, 1972; Papert, 1992; Roschelle, Pea, Hoadley, Gordin, & Means, 2000). Other justifications for exposing children to computers include expanding their access to information and communication resources and moving from delivery-based instructional practices to more active student-led ones (Osin, 1998).

Pedagogically, one-to-one computing represents an extension of the constructionist philosophy seen in earlier computing tools such as LOGO and the DynaBook. The idea is for students to have individual access to laptops (although the exact nature of access is often based on institutional policy), and for the laptops to be used for day-to-day instructional activities and assignments. The ultimate goal is for learners to have 24/7 access to the technologies of the 21st century workplace (Penuel, 2006) in order to develop the "21st century literacies" of the knowledge economy by working with productivity tools and the Internet (Grimes & Warschauer, in press). In recent years, the use of computers by children has been considered an important part of identity building apart from just knowledge construction. Many argue that the widespread use of the Internet and digital technologies have given rise to new ways of meaning-making due to the ways they have mediated work, life, literacy, and even identity. It is argued that new literacies have emerged with the use of screen-based technologies, as opposed to those associated with traditional print-based reading and writing systems. The practices of meaning making driven by the meditational effects of technology are variously referred to as "silicon literacies" (Snyder, 2002), "technological literacies", or "digital epistemologies (Lankshear & Knobel, 2003). Computers in educational settings are seen as having the potential to support the development of technological literacies required in 21st century workplaces (Dooley, 1999; Grimes & Warschauer, in press). In many countries, we are already witnessing young learners developing digital identities based on active, sustained use of various forms of technology including portable media players, touch-based phones, and handheld computers to manage their music, photographs, communication, and school activities (Becker, 2000b).

The focus on developing digital age literacies has directed attention towards what models of educational computing can best support the intertwined processes of day-to-day learning and identity building. One-to-one computing offers the potential to support these goals since it puts the control for learning in the hands of learners, and makes computers accessible to them in a way that other models cannot. In this sense, one-to-one computing represents the highest level of learner agency afforded to students, which from the constructivist perspective, is the ideal condition for knowledge construction (eg. Burton, 1999).

One-to-One Computing: Implementation Efforts and Learning Returns

One-to-one computing programs aim to provide laptops with Internet access to learners either for school use or for both school and home use (Grimes & Warschauer, in press; Penuel, 2006). The increasingly attractive costs of laptops as well as their size and portability are factors that support the feasibility of such initiatives (Penuel, 2006). Reportedly, the first instance of one-to-one computing in a school setting was at a private girls' school in Melbourne, which in 1990, launched a one-to-one laptop program for students in the 5th grade based on a recommendation by the principal (Johnstone, 2003; Warschauer, 2006). It seems however that the idea of using laptops on a one-to-one level quickly caught on as a trend even without a clear picture of the benefits such a model offered in such early implementations. For instance, soon after the Melbourne implementation, others cropped up in Australia and then the United States (Warschauer, 2006). The idea of distributing laptops to children in the United States was based on two factors: first, a vision of a more active, learner-centered style of computing that was observed during laptop sessions in the Australian schools (Johnstone, 2003); and second, a desire not to fall behind (for instance, Johnstone [2003, p. 269] provides a good description of the principal of a Washington state school commenting that American children would have to serve tea to the Australians if the United States did not catch up with the one-to-one computing wave).

In the United States, in 1997, Microsoft's Anytime, Anywhere Learning (AAL) Program was set up to promote the one-to-one laptop paradigm for children in schools (Warschauer, 2006). The program involved schools and school districts allowing students to buy or lease laptops for use in school (Penuel, 2006). Unlike earlier programs, the AAL program conducted an evaluation of the laptop program to explore the gains from introducing laptops in educational settings. In a longitudinal evaluation of the program over three years in a school district in Michigan, it was found that students with laptops surpassed students without laptops in writing skills, used the laptops with more skill and more efficiently, and engaged in more inquiry-based research (Ross, Lowther, Wilson-Relyea, & Wang, 2003).

As of 2008, an estimated 33 or more states in the United States have one-to-one laptop programs implemented in schools, school districts, or sometimes state-wide. In 2002, the state of Maine signed a contract with Apple Computers to provide iBook laptops to all 7th and 8th grade students as well as all teachers in the state, amounting to 34,000 students and 3000 teachers (Lei, Conway, & Zhao, 2008; Warschauer, 2006). School districts in Henrico County in Virginia and Cobb County in Georgia have embarked on laptop programs for all middle school and high school students, while other schools are also looking into one-to-one computer programs (Penuel, 2006). Outside the United States, the governments of Ireland, Canada, the United Kingdom, and New Zealand have spent millions of dollars on computing initiatives, particularly one-to-one computing (Lei, Conway, & Zhao, 2008). These are in parallel with mobile and handheld computing initiatives (Lei, Conway, & Zhao, 2008), as well as interactive whiteboard initiatives in many secondary classrooms (Triggs & Sutherland, 2009).

While many look at laptops for children as a means to foster active, student-centered, and self-directed learning (eg. Kay, 1972), others have specifically looked at laptops as having the potential to improve performance in terms of learning outcomes (Roschelle, Penuel, & Abrahamson, 2004; Penuel, 2006; Grimes & Warschauer, 2003). Much of this work has focused on a student to laptop ratio of 1:1, which has been found to have indirect learning benefits. For example, findings from a multiple case study revealed that the 1:1 ratio allowed students to progress through lessons at their own pace, and that peer collaboration and feedback was enhanced with the presence of the laptop (Dunleavy, Dexter, & Heinecke, 2006). In another multi-site case study, researchers found that perceptions of student engagement and motivation were positive with the laptops and teachers reported enhanced flexibility in lesson planning (Zucker & McGhee, 2005). It has also been found that when students have access to their own laptop (as opposed to sharing from a cart of laptops in school), technology use across the curriculum is enhanced, large group instructional practices decrease, and students' writing practices become associated with the laptop (Russell, Bebell, & Higgins, 2004).

In developing countries, the primary focus of computing has been on the human development angle rather than the pedagogical one. The reason is that technology is often viewed as an "enabler" within a larger process of micro and macroeconomic growth

within those economies. A spate of low-cost computing has recently emerged in developing countries, with various projects being initiated in developing countries to design low-cost computers (James, 2002). Low-cost laptop projects are often targeted at child audiences in educational settings, and thought to be "a means of improving and equalizing quality of education" (Patra, Pal, Nedevschi, Plauche, & Pawar, 2007, p. 4). The past few years have seen the launch of some prominent low-cost laptops specifically targeted at primary and secondary education, including the One Laptop Per Child (OLPC) XO laptop, Intel Classmate Tablet PC, Hewlett Packard 2133 Mini-Note PC, Acer Aspire One Notebook PC, and Asus Eee PC (Gaudin, 2008; Poeter, 2008; Nystedt, 2008). While some of these laptops are a part of larger implementation initiatives with explicit pedagogical goals (for example, the XO and Classmate PC), others are products manufactured by technology companies that have captured popular interest due to their reasonable pricing in comparison with regular laptops (for example, the Asus Eee). The XO laptop and Classmate PC are both explicitly designed to enable one-to-one computing (i.e., 1:1 student-computer use, with access to the Internet over a network of some sort, and the ability for learners to carry the laptops wherever they go).

The Lack of an Empirically-Supported Framework to Understand One-to-One Computing

Despite enabling increased access to computers in schools, scholars recognize that the returns from one-to-one computing initiatives are still uneven or ambiguous (Dunleavy, Dexter, & Heinecke, 2006; Grimes & Warschauer, in press; Penuel, 2006) even in developed countries. There are two potential reasons for this ambiguity. First, there is no agreed-upon definition of what constitutes one-to-one computing on the ground in terms of number of hours of access, extent and quality of use, regulation of ownership, and integration within specific contexts. It is variously taken to refer to high access computing, unlimited access to laptops at school and at home, or simply a student to computer ratio of 1:1 (Bielefeldt, 2006). The differing takes on one-to-one computing are problematic since they confound the knowledge base available to researchers and practitioners working in this area. Penuel's (2006) definition of one-to-one computing is

a step towards addressing this issue, although, further efforts are required by the education community at large.

Second, there is no evidence to guarantee that the uneven gains and challenges witnessed with traditional computing models in schools will not be repeated with one-to-one computing. For instance, there are doubts about what the gains are from investing in classroom technology, particularly when test scores on achievement tests have not improved over the past three decades (considered important by those who consider performance on scholastic tests the criteria for measuring gains from computer use). Further, it is often pointed out that computers are not used effectively in the classroom (by educators and students), and scheduling or logistical considerations affect the use of computers on a day-to-day basis (Grimes & Warschauer, in press). Practical concerns such as teachers' comfort levels and motivation to alter their practices, as well as situational constraining factors could also carry over to new models such as one-to-one computing (eg. Cuban, 1986; Doering, Hughes, & Huffman, 2003). Such past challenges raise many difficult questions about the value and future of one-to-one computing, especially since competing technologies continue to be manufactured and distributed at great speeds.

Further Challenges with One-to-One Computing in Developing Countries

Even as low-cost notebook makers are competing to enter developing markets, newer virtualization software and hardware is being targeted at replacing the one-computer-one-user computing paradigm by providing the ability for a single computer to be used by many users. NComputing's X300 is a desktop virtualization solution that allows multiple access terminals to be set up with a single PC (Patra, Pal, Nedevschi, Plauche, & Pawar, 2007). Such a solution brings down the cost of computing to $ 200 for three users as compared to that price (or often more) for a single user. Indian IT companies are already buying these "virtual" desktops to deploy in educational institutions that they support, and some companies such as NIIT have openly declared a preference for this technology over other low-cost PC projects such as OLPC's XO laptop due to the attractive cost proposition (Prasad, 2008).

Added to the competition from technology vendors, one-to-one computing is also being pitted against other tried and tested models of computing in developing country contexts, where a large part of its unfavourable evaluation is based on high costs and feasibility constraints, and in some cases, pedagogical considerations. For instance, Patra, Pal, Nedevschi, Plauche, & Pawar (2007) conducted an evaluation of three models of computer usage in 22 schools in India, studying each model for its suitability to context, economic viability, and educational effectiveness. The three models evaluated were: single ownership, single user per classroom or community-owned computer, and multiple users per shared computer. The student to computer ratios assumed for each of these models was around 1:1, 10:1, and 40:1 respectively. The study found that the costs associated with single user computing far surpassed those associated with shared computing. For instance, the cost of providing shared computers to all 149 million school-going children in India between the ages six to thirteen was estimated by them to be 1.06 billion dollars in contrast with 12.42 billion dollars to provide one-to-one computing. This is of course, not surprising, since the cost of one-to-one computing is perhaps one of the more significant barriers to its use.

In terms of the learning effectiveness of the different models, Patra et al's (2007) study comparatively tested four modes of computer use: single-user, single input mode; multi-user, single input mode; multi-user, multi-input competitive mode; and multi-user, multi-input collaborative mode. A short-term knowledge retention test was used where children in a real classroom setting were shown a set of English words they were previously unfamiliar with and then asked to identify them from memory using multiple-choice options. It was found that the multi-user, multi-input collaborative mode was most beneficial in that children retained the most and had a very low error rate. The explanation given for this was that the multi-input collaborative mode waited for all students to respond before moving to the next question. Thus, by collaborating with each other before answering, children were able to perform better. On the other hand, when working independently in the multi-user, multi-input competitive mode, children tended to be competitive and did not collaborate as much, resulting in a high error rate even though engagement was higher. Based on these findings, Patra et al. (2007) argued that shared computing could be a more practical and sustainable model of educational

computing than single-user computing for children in the Indian context. However, since the goal of many one-to-one computing programs is to foster process-oriented learning approaches rather than retention-oriented ones, there needs to be further emphasis on the process of learning itself rather than just the outcomes. Otherwise, much of the richness of the learning and identity-development process could be overlooked in favour of overly simplistic testable outcomes.

Clearly, in developing countries, cost effectiveness and feasibility are taken to be important or even tipping-point factors in making decisions about one-to-one computing (eg. Computer Aid International, 2009). However, with more sites of implementation of this model, particularly primary schools, it is becoming imperative to explore other considerations that might contribute to a clearer picture of the benefits and challenges of one-to-one computing in developing contexts. These considerations include the pedagogical value proposition, ground-level implementation challenges, access considerations and so on that might serve to balance the decision making process around adopting one-to-one computing. Further, if one-to-one computing is being viewed in developed countries as both a means to support active knowledge construction and a way for learners to develop 21st century technological literacies, we need to understand the value of these goals to learners in developing country contexts to develop a fuller picture of this computing model in such contexts. To that extent, the shortage of empirical work exploring these aspects of one-to-one computing in developing countries is problematic. How does this computing model support knowledge construction and the development of technological identities among children and school stakeholders? Exploring such issues is especially critical in developing countries where one-to-one computing is not the most current process of a logical evolution in access to computing, but often, the very first access to computers for school-going children.

Another point to note is that the low-cost laptops being promoted and deployed in developing countries such as the XO laptop are conceptualized and designed in the West, and are thus based on pedagogical models that have so far only been tested in Western contexts. What happens when these technologies enter a very different context of education? Why is it meaningful to have 1:1 access to computers in developing country contexts? How does 1:1 computing for low-income children translate from goal to

execution? To begin to explore such questions, this study considers the case of the OLPC initiative's XO laptop (popularly referred to as the 100-dollar laptop) as an educational technology intended for low income children in developing countries. The mission of the OLPC program is to provide dedicated XO laptops to children in developing countries. The laptops are equipped with both educational software as well as Internet and local area network access. In this sense, the goal of the OLPC is to achieve one-to-one computing as Penuel (2006) defines it. This thesis work focused on studying how this goal translates into ground-level implementation.

The OLPC laptop was selected for this study for three reasons. First, as mentioned earlier, an explicit part of its purpose is to provide unlimited access to laptops and the Internet for child learners. Since this is in sync with one-to-one computing, I believed this would be a good opportunity to explore how one-to-one computing translates from goal to execution. Second, the XO laptop is unique in comparison with other regular laptops since it is consciously designed as a pedagogical tool equipped with a range of educational activities specifically for child learners. This raises the question of whether the various reputed pedagogical activities installed on the XO laptop might shape how and what children learn with the laptop. Third, the XO laptops are being targeted at developing countries rather than developed ones, where the knowledge of implementation benefits and challenges of one-to-one computing is still embryonic. Studying a developing country implementation of one-to-one computing represented a chance to contribute to an area little explored so far.

CHAPTER 3 — THE CURRENT STUDY

> To create educational opportunities for the world's poorest children by providing each child with a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self-empowered learning. When children have access to this type of tool they get engaged in their own education. They learn, share, create, and collaborate. They become connected to each other, to the world and to a brighter future (OLPC Mission Statement, 2009)

Macro Context: The One Laptop Per Child (OLPC) Initiative

OLPC is an example of an educational technology initiative intended to address the digital divide (Buchele & Owusu-Aning, 2007). OLPC is an educational program established by Nicholas Negroponte and a project group at MIT's Media Lab in January 2005, based on Negroponte's vision for a 100-dollar laptop. The goal of the initiative is to deploy millions of rugged, low-cost laptops (the XO laptop) to children in developing countries worldwide. The laptops are designed around a constructionist philosophy of learning. Inspired by Seymour Papert's work in constructionism and the LOGO language (Papert, 1993; Papert, 1992), and Alan Kay's DynaBook proto-laptop (Kay, 1972), the XO laptop is intended to provide technological access while enabling children to learn collaboratively using technology. OLPC's educational proposition is to replace top-down educational paradigms with a learner-centered model where students are provided with a versatile tool to help them become creative learners (OLPC Vision, 2008).

Despite its launch in many developing countries, the OLPC initiative has also met with criticism on many levels including its failure to meet the target cost of a 100 dollars (the laptops in reality were priced at double that figure) [Shah, 2007]. From the education perspective, Kozma (2007) argues that simply providing computers to schools without taking an overall systemic approach to integrating them will have little effect on education. Another common criticism of the OLPC initiative is based on the practicality of the technology in remote rural areas of developing countries where electricity and Internet access are not available (Buchele & Owusu-Aning, 2007). There has also been

government-level resistance to the OLPC initiative, most notably by the Indian government. When the Planning Commission of India presented the proposal to adopt OLPC in India, the Ministry of Human Resource Development rejected the idea. The rationale for the rejection was that the investment would be better spent on basic needs such as classrooms and teachers, as well as on another proposal to achieve the universalization of secondary education in India (Zee News, 2006). The universalization of primary education has long been a goal of the Indian Constitution's Five Year Plans (Tilak, 2006), beginning with the aim of "free compulsory education for all children aged 14 or less by 1960" (Panagariya, 2008, p. 432). For a variety of reasons, this goal has not been achieved and about 8.9% of children in rural areas between the ages of six and fourteen are not in school (Panagariya, 2008). Common problems include untrained teachers, teacher absenteeism, lack of infrastructural resources, and lack of family support for education among others (Tilak, 2006; Panagariya, 2008). Many of these problems in turn lead to poor attendance and challenges in retention after enrolment, resulting in many children not having the opportunity to receive even a basic education. Gender and spatial divides in access to education are also common (Tilak, 2006). To this effect, the minimum needs justification of the Ministry of HRD in India certainly has merit, in terms of its intention of directing the costs that would be incurred to purchase and support laptops towards achieving basic education goals and giving all children equal opportunity to a quality education.

Despite the rejection of the OLPC initiative by the Indian government, several batches of OLPC laptops have been deployed to at least seven urban and rural schools in India with another five potential schools being targeted. The deployments have been the result of the OLPC partnering with private corporations and non-governmental organizations in India (OLPC India, n.d.). The deployments in India began in 2006 with a pilot in a one-room schoolhouse in the Khairat village in Maharashtra (OLPC India, n.d.). In addition, many supporting projects such as educational software development, language localization, and a web-based student training resource are being implemented or planned (OLPC India, n.d.).

The fact that the OLPC and private organizations are seeing value in distributing XO laptops to primary school children in India makes it important to explore what

actually happens when these laptops are distributed and used, as situated within the many surrounding forces such as local educational policies and curriculum, technology expectations, social relations, and cultural values. The presence of these multiple OLPC implementations in India provides prime opportunities for empirical study, which could then serve as a basis for theory building and policymaking. In fact, such empirical work is particularly necessary, since simple project overviews or first-day implementation chronicles are the only information available about these projects on the OLPC Wiki (http://www.laptop.org). It has been recognized that this is the case with OLPC projects not just in India but globally (Kraemer, Dedrick, & Sharma, 2009; Bentley, 2007).

In addition, although Negroponte calls the OLPC an "… education project, not a laptop project", doubts have been expressed about how the OLPC is supporting local educational systems in integrating the laptop, or if in fact, the laptops are simply being distributed with some initial support (Kraemer, Dedrick, & Sharma, 2009). The perceived lack of a systemic perspective around the OLPC is a concern from both an education and development perspective. Kozma (2006, p. 4) points out that "Information, communication, technology, and education must be viewed as a system in which the components work together to support development." If the OLPC considers the deployment of an XO laptop for each child to be an agent for educational reform, then we must ask what efforts are being made to integrate the laptops within educational contexts having specific curricula, pedagogical practices, and training resources.

> Reforming education is hard work that involves making coordinated changes in pedagogy, curriculum, assessment, and teacher training, as well as technology. While any one of these factors — such as technology — can be used as a lever to launch other changes, reform has to be viewed as systemic change. Without coordinating all of the components, it is more likely that change in a single factor — such as technology — will be merely assimilated into the current system unreformed or be rejected altogether (Kozma, 2007b).

Using a Systemic Perspective to Study the OLPC Initiative

Cuban's (1986) exploration of the problems with integrating technology in schools, particularly the role of teachers in the classroom use of technology, highlights the importance of systemic factors in explaining how technology is used in educational

settings. One particular explanation for technology use highlighted by Cuban was the idea of "situationally constrained choice" (p. 66), namely, the systemic, cultural, and efficiency factors hindering the effective use of technology on a day-to-day basis.

> I believe that teacher use of machine technology can test how applicable situationally constrained choice is as an explanation of teaching practice. The explanation I have constructed argues that, because of the severe constraints imposed upon teachers by the classroom and school as workplaces and the imperatives of their occupational culture, teachers will seek out those tools that meet *their* tests of efficiency: Is it simple? Versatile? Reliable? Durable? What is the personal cost in energy versus return in worth for students? Will these new machines help solve problems *teachers* (and not nonteachers) define? (Cuban, 1986, p. 66)

Cuban's (2001) study of technology use in the classroom from the dual perspectives of teachers and policymakers explored the challenges faced by teachers (in the United States) when school reform agendas advocate new technologies, Cuban highlights the problematic assumption made by what he calls "techno-promoters". This is the problem of assuming that the availability of technology naturally leads to its use, and in turn to efficient teaching and learning. Both Cuban's description of "techno-promoters" and Papert's (1987) description of technocentric thinking seem to be referring to a "tool ontology" viewpoint (Introna, 2007), which places the onus of reform on the tool itself. In reality, the integration of technology depends on a variety of factors as Warschauer, Knobel, et al. (2004) and Cuban (1986) have pointed out. For instance, teachers are considered key to the integration of technology and students' learning with technology (Triggs & Sutherland, 2009). Other more recent studies have brought similar ideas to light — for instance, Warschauer, Knobel, et al. (2004) in studying eight California schools found three key factors affecting the integration of computers into the curriculum: *workability*, or the functional reliability of technology; *complexity*, or the challenges in integrating technology with instructional activities; and *performativity*, or the tendency to make measurable performance the priority.

The importance of understanding contextual factors in developing country contexts was seen in the case of the World Bank Institute's *World Links for Development (WorLD)* program which provided schools in 27 developing countries with networked computers. The program took a systemic approach to technology integration to support

teachers in integrating the computers into their day-to-day teaching (Kozma, McGhee, Quellmalz, & Zalles, 2004). Intended to prepare learners in developing countries to participate in the global knowledge economy, customized programs were developed for target countries considering the educational system as a whole, including teacher professional development, community participation, technical support, educational policy, and gender equality among others (Hawkins, 2002). Interestingly, it was the first launch of the program in Uganda that made apparent the types of issues that could be encountered in integrating technology in developing countries. Some of these included the lack of wireless technology, poor telecommunications infrastructure, difficulties finding and training computer support technicians, gap between technology and larger educational policies, and gender gaps (Hawkins, 2002).

This study aims to address the shortage of empirical work surrounding local implementations of the OLPC program by examining the social, systemic, and educational experiences with the XO laptop at a micro-level. Further knowledge is required about what happens when the one-to-one computing paradigm is implemented in a developing country context and about the "situationally constrained choices" (Cuban, 1986, p. 66) associated with the XO laptops within a context of use.

A systemic perspective to study classroom technology represents various stakeholders' voices as a starting point to understand technology integration and use, as opposed to traditional top-down processes of reform. This approach shifts the lens of exploration to technology as situated within educational contexts and only then works upwards towards policymaking. In doing so, we drill down to the level of detail — the curricula and pedagogical practices relevant to the context, the learners who belong to it, the educators who practice within it, the administrators who manage day-to-day operations, and the local policies that shape learning outcomes. An evolving perspective on technology addresses these crucial areas — it is based on the idea that when technology becomes a part of a system, it is no longer an independent *subject* acting upon the *objects* in the system, but rather, is embedded within the system.

The "social embeddedness" perspective is concerned with understanding technology in various contexts of use (Warschauer, 2003; Morales-Gómez & Melesse,

1998). As Sassen (2004) claims, technology is embedded in social structures and social relations, is used by individuals and groups that move between physical and technological worlds, and is mediated or reconstituted by the cultures that take it up. In this view, it is less productive to think of technology and society as a duality, but rather, as a co-constitutive system.

> While a digital divide framework suggests that technology 'impacts' a social situation, in fact, technology and society are co-constitutive. While technology can help shape social relations, social relations also shape how technology is developed and deployed (Warschauer, 2003, p. 301).

This thesis adopts the social-embeddedness perspective as a lens to explore how the systemic particularities of a given educational context and the introduction of an educational technology are co-constitutive. The social-embeddedness perspective is a theoretical lens that draws from the field of social informatics, which deals with the relationships between society and technology (Oostveen, 2007). It views technology as situated in a larger web of social relations, power structures, policies, identity, history, and individual interests. Context is integral, and this perspective is concerned with exploring the interaction of various system factors including roles, goals, conflict, communication, and rules (Kling, 1980).

Purpose and Research Questions

Drawing from the social-embeddedness theoretical perspective, the purpose of this study was to micro-inspect the "lived experience" of learning with the OLPC laptop (Silverman & Marvasti, 2008; van Manen, 1990).

> The understanding of some phenomenon, some lived experience, is not fulfilled in a reflective grasp of the facticity of this or that particular experience. Rather, a true reflection on lived experience is a thoughtful, reflective grasping of what it is that renders this or that particular experience its special significance (van Manen, 1990, p. 32).

In this work, the "lived experience" referred to the actions, interactions, social relations, cultural adaptations, and pedagogical practices surrounding the use of the OLPC laptop. Extending van Manen's description of lived experience, the goal was not to simply describe the fact or enactment of the experience(s) but to take an interpretive

stance and explore the various members' meanings. The goal in taking an interpretive stance was to specifically focus on the richness of details within the phenomenon, in order to develop a deep understanding of an OLPC implementation through the experiences of all stakeholders associated with the program. Such an approach is critical in such early work in one-to-one computing in developing countries because it reveals individual and collective experiences, values, and relationships that are embedded in situation or context. For instance, as Sherman & Webb (1988, p. 16) argue, "Experience itself is 'bounded'; it is not anything and everything in the world, but a *context*".

The following research questions were asked:

- How does the intention of one-to-one computing translate into execution on the ground?
    - How is access to the OLPC laptops enabled or regulated?
    - What expectations do stakeholders (management, teachers, principal, volunteers, and students) have of the OLPC laptops and what does this reveal about their technological values and identities?
    - In what ways are the OLPC laptops used for instructional purposes?

CHAPTER 4 — METHODS

Methodology

This study adopted an instrumental case study methodology. The instrumental case study is useful to develop understandings of a particular phenomenon, using a specific case as a point of reference (Stake, 1995). In this case, the purpose was to explore how one-to-one computing translates into daily use within a given social, cultural, and educational context. Hence, theoretical sampling was used to identify a useful case to serve the study of one-to-one computing. Stake (1995, p. 2) describes the case as a "bounded system", and in this study, the bounded system was taken to be all stakeholders and practices associated with the implementation of one-to-one computing in a non-profit school for socially disadvantaged children in India. A key aspect defining this case was that it focused on understanding one-to-one computing "on the ground" in a developing country context. Defining the case (Klotz, 2008) and the bounded system (Stake, 1995) helped provide further specificity on what research questions needed to be asked to understand the lived experience with one-to-one computing.

The purpose of using a case study approach was to provide a micro-level "direct and vicarious experience" (Stake, 1978, p. 5) of the school's experience with introducing and integrating the OLPC laptop. As pointed out earlier, little empirical work exists about one-to-one computing in developing countries, making it important for early work in this area to capture the complexity of the system studied in terms of its particularities (or as Stake (1995) puts it, to aid particularization). Case study research is well suited to such a goal, since it is concerned not just with the demographics of a case but more importantly "the experiences and perceptions of participants" (Mabry, 2008, p. 215).

An interpretive case study aims for particularization by recognizing that multiple realities are possible, and representing these through the voice of multiple participants (Stake, 1995). One goal of the interpretive study is to use "thick description" (Geertz, 1993) to explore processes of meaning making and symbolisms of human behavior.

> The concept of culture I espouse, and whose utility the essays below attempt to demonstrate, is essentially a semiotic one. Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in search of meaning. It is explication I am after, construing social expressions on their surface enigmatical (Geertz, 1993, p. 5).

> A good description that constitutes the essence of something is construed so that the structure of a lived experience is revealed to us in such a fashion that we are now able to grasp the nature and significance of this experience in a hitherto unseen way (van Manen, 1990, p. 39).

I chose an interpretive approach to study this case for two reasons: first, since little empirical work exists about one-to-one computing in developing countries, I believed that early efforts in this area needed to focus on developing a rich understanding of ground-level implementation factors and participant perspectives before attempting theory building or measurement; and second, since an interpretive approach would best represent the multiple voices of a group of stakeholders, each with specific roles and responsibilities (eg. learners, teachers, management, administrators, and volunteers), and therefore, with a different perspective on similar issues. By exploring the idea of one-to-one computing through observations of its implementation and interpretations of stakeholders grounded in their everyday experiences (eg. Crabtree, Miller, & Stange, 2001), this study aimed to develop a holistic understanding of implementation factors and issues associated with this model of computing in developing country contexts.

The approach to this case study was naturalistic, drawing from Lincoln & Guba's (1985) naturalistic inquiry paradigm. In the naturalistic paradigm, the goal is not to make "time- and context-free generalizations" (p. 37) as in the positivist paradigm (Lincoln & Guba, 1985). Hence, the findings from this case study are expected to be taken as "idiographic interpretations" (p. 42) that represent *this* case deeply and reflexively. The transferability of these findings is both time and context dependant. Any further generalization is contingent upon an understanding of the new context to which the findings are being transferred. To this end, Stake (1995, p. 7) refers to generalizations from a case as "petite generalizations". One avenue for extending the generalizability of

the findings would be to conduct multiple such case studies in different contexts to gain a rich and deep understanding of one-to-one computing in education that can then be used as a starting point for further generalizations and theory building.

Site and Context

Theory sampling (eg. Creswell, 2002) was used to select the site for this study in order to balance two needs: first to identify a program that allows for the study of how one-to-one computing is implemented on the ground, and second, to choose a site that I could relate to best as a researcher in terms of familiarity with the context, language, and culture. I started broadly initially, selecting four potential sites of study in developing countries where OLPC programs were being implemented: one in Central America, one in South Africa, and two in India (in two different states). Having been born and raised in a developing country (India) which has multiple intersecting subcultures, languages, and dialects, I initially thought that this might be a benefit in helping me understand the context of developing countries in general. However, I quickly realized that an integral part of understanding a new developing country context is also a command over the local language as well as non-verbal communication cues like gestures and expressions, and even in a few months, I would possibly not be able to develop enough of a competency in the local language to be able to interpret the finer nuances of communication that are integral to a rich understanding of a phenomenon. Once narrowed down to the two sites in India, I again used the same rationale to select a site to study. I chose the site in Bangalore (in the South Indian state of Karnataka), which was where I grew up and was thus very familiar with the local language, Kannada, as well as the local culture. The other site was a village in Maharashtra, where the regional language is Marathi. Although I understand and speak Hindi, which is similar enough in terms of vocabulary, I would have needed a translator or interpreter to follow social interactions and interview responses, and even then, there was the risk of "loss in translation". Hence, the Bangalore site seemed the ideal choice for this study.

The site was a private non-profit school called Yuva[2], located in Bangalore. The school is located a few kilometres from the city's central business district, and run by a non-profit Foundation called Yuva. Yuva runs four schools in the city. Bangalore is a major metropolitan city in India, and the capital city of the state of Karnataka. With a total population estimate of more than 6 million, it is India's third most populous city and one of the fastest growing cities in India (Benjamin, 2000). Bangalore is a major IT hub of India (often called the Silicon Valley of India), and its IT sector employs over 650,000 people in over 3000 companies (Yuva Official Presentation, n.d.).

Yet, despite its outward appearance of affluence, out of Bangalore's population of over eight million (in 2008) [Jacob, 2008], an estimated two million live in slums. Many occupants of slums are migrants from rural areas, looking for better opportunities in the city. Migrants to Bangalore come both from within the state as well as from the neighbouring states of Tamil Nadu, Andhra Pradesh, and Kerala, contributing to Bangalore's already multi-ethnic society (Benjamin, 2000). Amenities available to slum dwellers are either basic or non-existent. About 30% of Bangalore's population reportedly has either partial or no access to piped water and depends on public water foundations where the quality of water is questionable. Homes are basic with poor access to sanitation. Hundreds of thousands of slum dwellers do not have a personal toilet within their home and depend on public facilities or open areas when the charges for public facilities are beyond their budget (Benjamin, 2000).

Sociocultural and Economic Background of Students

Yuva's four schools admit children of urban-migrated slum dwellers who live in either designated or non-designated slums in Bangalore. Other children are selected from three orphanages in the city. Children at the school are in the age range of five to fifteen years, with an almost equal gender split (420 girls and 430 boys). The children come from low socioeconomic status families in India, with the average monthly household income being about Rupees 1000-1500 (i.e., 20-30 US dollars) and the average number

[2] The names of all organizations and individuals in this study have been changed to protect their identities and privacy.

of people in the household being five people (Yuva website, n.d.[3]). The Indian government stipulates the poverty line for urban areas to be Rupees 296 per month per person (iWatch, 2008). The household income reported by the families of Yuva's students is often below this figure (Yuva website, n.d.). By this token, the families are considered to be Below Poverty Line (BPL). The World Bank classifies the poverty line for developing countries much higher at US dollars one per day per person (amounting to almost Rs. 1500 per person per month). Since the Indian government classification more realistically depicts the total household income figures seen with Yuva families, it is the value used for classification in this work.

Yuva admits children from vulnerable homes and backgrounds, including abandoned and orphaned children, children from abusive homes, children with alcoholic parents, and those without medical care or access to basic nutrition. Siblings of selected children are given preference. Yuva meets its operating costs through corporate partnerships with prominent organizations as well as individual donors.

OLPC Laptops for Second Grade Children

Between June and September 2008, 29 XO laptops were distributed to the school for second grade children to use as a part of their day-to-day learning. The funding for the laptops was provided by a Dutch couple. The distribution of the laptops was carried out by a private Foundation in India that the OLPC partners with (The Information Age Foundation[4]). As of September 2008, the laptops started to be used by the second grade class (named Venus class, in keeping with the naming convention of the school where classes are named after the planets in order starting from the Sun for the Upper Kindergarten [UKG] class). Throughout this study, the class will be referred to as the Venus class or the second standard class, which is how it is referred to locally. This study focused specifically on the Venus class, since the OLPC laptops are currently used only by the children of this class.

[3] The Yuva artifacts used for reference have been credited, but are not listed in a Reference List or Bibliography to protect privacy.

[4] Name changed

Participants and Sampling

The primary participants were 32 Venus class children from the Yuva Center for Learning, to whom the OLPC laptops have been assigned. Other participants in this study were the teachers and volunteers associated with the second standard class and the laptop program, the principal of the school, the CEO and Founder of the school, the social worker handling admissions and family issues, and ancillary support staff associated in any way with the laptop program. Initially, specific participants were selected using purposeful sampling (Silverman & Marvasti, 2008; Mabry, 2008) to aid the generation of a deep understanding of the OLPC program in the context of the school (Creswell, 2002). In terms of the sampling procedure for participants, the focus was on choosing a variety of participants with different roles to adequately explore nuances of interpretation that might vary depending on age group, position in the system, familiarity with technology, and day-to-day goals. This form of sampling is often referred to as maximal variation sampling (Creswell, 2002). In this first phase of sampling, the students, teachers, school administrators, and third parties associated with the OLPC program were targeted.

As data collection progressed, a second set of participants were selected using a process of snowball sampling, which involved asking the existing participants to suggest other participants who might help provide a better understanding of the OLPC program implementation (Creswell, 2002). For instance, the class teacher suggested several other participants who might be able to provide a good understanding of the school system and the laptop program. This second phase helped expand the scope of the participant base by including the activities and views of social workers associated with the school, the senior management, and volunteers with the school. Table 1 lists the participants associated with this study, and describes their role at Yuva.

Table 1 - Participants in the Study and their Role at Yuva

Participant(s)	Role at Yuva and Reason for Selection
32 children	All the students of the second standard class were observed and photographed as a part of this study. Out of the 32 children, six were selected to interview based on the same maximal variation sampling approach (Creswell, 2002) to obtain views of students across genders, performance levels, and classroom engagement levels. Four boys and

Participant(s)	Role at Yuva and Reason for Selection
	three girls were interviewed. Out of these, two were high-performing students as highlighted by the class teacher and day-to-day observations, two were average performing students but with a high level of engagement in class activities, one was a "mischievous" student easily distracted during class activities, and one was a quiet student but who sometimes appeared disengaged from class activities. The students selected were also chosen across the 8-9 years age range, across genders, and across religious backgrounds (Hindu, Muslim, Christian) to explore potential differences in perceptions. The shortlisted students were contacted and interviewed during non-peak class hours after obtaining permission from the class teacher and consent from their guardian.
1 class teacher	The dedicated class teacher of the Venus class was an integral part of this study. She handles day-to-day instructional issues, assessment, and class management. She also has a subject teaching role which includes Math and English for the Venus class and social studies for a higher class.
1 computer teacher	The teacher who manages the computer lab and teaches computers to all classes in the school was selected to participate in this study since she is both the primary anchor for the laptop program and the caretaker of the laptops on a daily basis. Her ancillary duties include typing up key school documents including final examination papers.
1 OLPC volunteer	Another key participant in this study was a volunteer external to the school who is responsible for the day-to-day planning, creating, and loading of laptop lessons, as well as facilitating the class activities during the laptop session and clearing queries and doubts. She is not associated with the OLPC organization in any way.
Principal	The principal is the administrative head of the school in charge of day-to-day operational planning and issues. She is also the point of contact between the teachers and the senior management of the school. The principal was selected to interview since she would be able to provide both the management and teachers' perspectives on laptop use, being a mediator between these two distinct functional units of the school.
Social worker	The social worker from the Community Development Services (CDS) department of the school was selected to interview since she handles outreach to potential students, the admission and selection process, as well as day-to-day issues with children and families. I believed her views would be important to understand the background of the children and operational issues associated with this vulnerable population.
1 subject teacher	The subject teacher who handles the Environmental Science (EVS) subject for the Venus class was selected to participate even though she

Participant(s)	Role at Yuva and Reason for Selection
	is not associated with the laptop program. The reason for selection was to get a wider sense of the various instructional styles adopted with the Venus class even during non laptop sessions. I thought this might help to contrast laptop and non laptop sessions, as well as differences between different teachers' classrooms.
CEO and Founder	Another key participant in this study was the founder of the school, who is in charge of school governance, fundraising, strategy, management, and all the administrative divisions of the school. She was selected to interview since she is in charge of all school programs, activities, and decision-making processes, and would be able to provide the higher school-level rationale for introducing the OLPC laptops.

Table 2 below introduces the various participants of the study with their assigned aliases. These aliases are used through the remainder of the study to refer to participants. No real names of participants are used in this study to protect confidentiality and privacy.

Table 2 - Introducing the Participants associated with the OLPC Laptop Program

Name	**Participant Role**
Lalita	Class teacher (Venus class)
Runa	EVS teacher (Venus class)
Anjana	Social worker (Community Development Services department)
Priya	Principal of the school
Veena	OLPC volunteer
Munira	Computer teacher
Sarika	CEO and Founder
Grace	Library teacher/Substitute teacher
Shubha	General school volunteer
Sheba	Child one (female, Christian, 9 years)
Arif	Child two (male, Muslim, 9 years)
Pramila	Child three (female, Hindu, 8 years)
Neeta	Child four (female, Hindu, 8 years)

Name	**Participant Role**
Raj	Child five (male, Hindu, 9 years)
Pradeep	Child six (male, Hindu, 9 years)
Amir	Child seven (male, Muslim, 9 years)

Data Collection

This study adopted multiple methods to understand the experiences and perceptions of participants involved in the OLPC program at Yuva. Permission was obtained from Yuva to conduct the study and spend a month at the premises collecting data. Written consent was obtained from all participants after providing a study information document and a verbal briefing of the project, and in the case of children, from their guardian. No participants declined to participate in the study. Apart from obtaining written consent prior to data collection, participants were again debriefed at the end of each interview and asked if they were comfortable with all of their responses being analyzed. I gave them the option to choose any part of their inputs that they were not comfortable with, if they wanted these to be omitted from the study. No participant availed of this option. All participants conveyed that they were comfortable standing by their inputs.

Three primary data collection methods were adopted including observations, interviews, and photographs for visual analysis. In addition, a variety of documents were collected pertaining to the school's pedagogical philosophy, the laptop program goals, and the actual lesson activity files. A methods log was maintained through the data collection period, which comprised individual logs for observations, interviews, and photograph sessions. The multiple methods were adopted for two reasons: first, as a means to triangulate any emergent findings (Mathison, 1988); and second, as a means to establish "structural corroboration" which involves comparing emergent data and interpretations to check for contradictions or alternative explanations (Guba, 1981, p. 85; Patton, 1999). While the purpose of triangulation is often to arrive at a particular proposition by eliminating rival explanations (Mathison, 1988), in this study, the objective of methodological triangulation was to make it possible to explore the case

through the lens of more than a single method and through the experiences of multiple participants. The purpose was not to eliminate subjective interpretations (which are integral to naturalistic work such as this), but to use a comparative lens to understand and interpret the findings. Along with the "prolonged engagement" at the location over a month-long period (see Guba, 1981), I paid attention to analyzing and reporting contrasting participant perspectives and actions.

Observations

Observations were conducted in a naturalistic setting (the classroom and other spaces associated with Venus class activities) for the duration of one month between February and March 2009. All laptop sessions and non-laptop activities were observed during the month-long period. Non-laptop activities were observed to gain an overall picture of day-to-day classroom activities, social relations, and pedagogical approaches of teachers. When these involved moving out of the classroom to other areas of school, I accompanied the class to the new location. Laptop sessions were observed from both a standalone perspective to understand how the laptops were being used, and a comparative perspective to understand whether there were similarities or differences in sessions with and without the laptops. Appendix B comprises the detailed observation log for the one-month period.

Throughout the observations, a theoretical sampling process was followed (eg. Corbin & Strauss, 2008), in which each subsequent stage of the research design was adapted based on the data collected in the preceding stage. For instance, data collected during observations on a given day was used to modify future interview transcripts to explore specific concepts that emerged. This process of progressive focusing and refocusing (Stake, 1995) is an integral part of developing deeper understandings in a case study approach.

While my role in the observations was usually as observer, some sessions involved my taking on a participant observer role. This was possible due to the flexible nature of Yuva's system, where external volunteers are an integral part of day-to-day activities. Even though it was common knowledge that I was researching the OLPC

laptop, I was quickly immersed into the system like a volunteer would be. This implied that I was often asked to get involved in some classroom activities such as teaching a block period of art, helping distribute reading material and exercise books, minding the class while a teacher was away, and helping the class teacher with offhand requests such as mending some torn reading cards or checking answers to spot quizzes. The opportunity to experience the system like an insider would was valuable in helping me understand the values, perceptions, and expectations underlying day-to-day instructional practices. Dwyer & Buckle (2009) present the idea of being an insider-outsider in qualitative research, which involves the researcher having both the positionality of being inside the system and that of being an outsider to it (i.e. occupying "the space between") (p. 60). The value of such a dialectical role is that the intimacy of being an insider allows for a closer, relational understanding of the system under study, while the ability to retreat back to the outside allows the researcher to again "make the familiar strange" (Comaroff, 1992, p. 6).

> The notion of the space between challenges the dichotomy of insider versus outsider status. To present these concepts in a dualistic manner is overly simplistic. It is restrictive to lock into a notion that emphasizes either/or, one or the other, you are in or you are out. Rather, a dialectical approach allows the preservation of the complexity of similarities and differences (Dwyer & Buckle, 2009, p. 60).

Understanding the local language (Kannada) as well as another South Indian language spoken by many students (Tamil) was useful in helping understand smaller interactions among children in which they slipped from English (the language of instruction) to their mother tongues, as well as the colloquialisms children used on a daily basis.

One aspect of the observations that was challenging was the issue of dealing with my own values and biases along two dimensions: first, coming from a different socioeconomic background; and second, the fact that I had access to computers at home during my growing years. Coming from a lower socioeconomic background disadvantages individuals not just in explicit ways (such as lack of food, healthcare, and resources) but also in implicit ways (for example, not being aware of norms and behaviors practiced by society at large). An instance of this that I observed was the fact

that many children had little home training in the "publicly-acceptable" social behaviors that I had either tacitly or explicitly learnt by virtue of being part of the dominant "middle class". This included behaviors I had unconsciously come to accept myself to be the norm such as waiting in line for my turn, not speaking at the same time as another person, not talking with my mouth full, and so on. Only as I became engaged in this context did I for the first time question my own preconceptions about what the norm means. For instance, undertaking this study helped me to appreciate that as sections of society, we construct rules of conduct that we take to be common knowledge. However, when we step outside our own contexts into other sections of society, we become witness to different norms and rules of conduct (i.e., common knowledge means something else altogether).

I began to comprehend more realistically how common knowledge is constructed in response to social contexts and socially constructed positions in society. For instance, I observed that while the children fought amongst themselves to gain access to opportunities (perhaps a survival impulse), they often responded deferentially towards external volunteers and visitors when asked a question or asked to do something. The latter might be from observations of their own families, who often work as paid labour (for example, in construction and households) for poverty wages. Hence, it would be simplistic for me to assume that children from disadvantaged backgrounds would behave in the predictable ways I was used to seeing in other socioeconomic brackets. I thus paid attention to observable behaviors but also to the possible reasons underlying the behaviors, in order to represent the multiple realities that participants have constructed in their wholeness rather than their outward manifestation alone.

Secondly, having access to computers at home helped me to develop certain skills and expectations around computer use that I could not assume to be an experience shared by the participants in this study or even by their family and peer groups. Therefore, I tried to be careful not to make quick judgments about participants' use of computers by focusing not on participants' "performance" with computers but rather on their experiences and perceptions of finding their feet with educational computing. Further, even though my experiences with technology have been positive, I could not presume that this would be the case for others as well since this is based on exposure, context, and

experiences. As Caelli, Ray, & Mill (2003) point out, research is never value-neutral and interpretations are embedded in the values and presuppositions of the researcher. To address this, I consciously focused on eliciting and presenting participants' different feelings about technology in order to represent the diverse ways in which we develop our technological identities. Simultaneously, wherever relevant, I have presented my own experiences with technology in the classroom as a lens of comparison.

Interviews

A total of 19 interviews were conducted with 15 different participants over the one month duration of the study. This included six Venus class students, the computer teacher, the class teacher, the OLPC volunteer, one subject teacher, the principal, one general volunteer, the CEO and Founder, a social worker, and the library teacher. The computer teacher and OLPC volunteer were interviewed twice, starting with a preliminary interview early on in the observations and succeeded by a follow-up interview after further observations. The class teacher was interviewed multiple times, both because the amount of "free" time she had each day was limited, and because further questions naturally came up during observations, which were captured in the form of semi-structured within-setting interviews in cases when a class session was in progress. Three distinct types of face-to-face interviews were conducted depending on the context of the interview. The types of interviews conducted were: semi-structured, depth, and unstructured interviews. The focus of the interviews was to explore and represent "members' meanings" (Emerson, Fretz, & Shaw, 1995, p. 112). All interviews were audio recorded and I also made hand-written interview notes, which were used for analysis. The interviews were all transcribed, usually on the very same day, to keep the large volume of data organized. The detailed Interview Log is available in *Appendix A* and the Interview Guides in *Appendix C*.

Semi-structured Interviews

The semi-structured interview format (Crabtree & Miller, 1999, p. 19) was used for the majority of interviews in this study (17 of the 19 interviews). The focus was to use loosely-guided questioning to cover specific topics or aspects of the OLPC program, in

combination with open-ended questioning building on participants' responses. An interview guide was developed for each semi-structured interview. While initial interview guides had been created prior to the start of data collection, each guide was adapted as the process of data collection progressed. The actual questions asked varied by participant, but broadly spanned their role in the school and the laptop program, their thoughts on 1:1 access to computers for children, their experiences implementing laptop sessions, and future plans for the laptops. The class teacher was also asked about the curriculum, assessment modes, Long Range plans for the year, and daily operational aspects. For the computer teacher and OLPC volunteer, questions focused on the phases of introducing the laptops, goals and expectations of the laptop program, activities and features of the laptop, and logistical issues. Interviews with the teachers and principal were started with an open-ended question asking the interviewee to share their overall thoughts about the XO laptop. The purpose of this opening question was twofold: first, to act as a starting point to build further questions based on participant responses; and two, to understand how different participants viewed the laptop and the aspects of its use that seemed important to them without prompting specific inputs on these and without the background of other leading questions.

A second time-condensed form of the semi-structured interview was conducted for the students, spanning a 30-minute period for each child. The reason for condensing the interview duration for the child interviews was because a pilot spot interview with the first child revealed that attention began to wander after about 20-30 minutes, and questions after that period were evaded or children were distracted by others playing outside. Hence, an originally expansive interview guide was redesigned to capture as much information as possible in a limited period. Since the child interviews were the last interviews to be conducted, the limited duration of the interviews did not pose a problem since the lines of questioning and clarification had become apparent by then (Crabtree & Miller, 1999). The questions were mainly open-ended, with some closed-ended questions prompting for demographic background information such as age, number of members in the students' family, and so on. The child interviews included questions exploring three areas: the childrens' sociocultural background, exposure and access to computers outside school, and their thoughts on using the OLPC laptop.

Another derivative of the semi-structured interview was conducted within the class setting as laptop or non-laptop sessions were in progress, in order to gain a deeper understanding of the "lived experience" of the classroom on a daily basis (eg. Silverman & Marvasti, 2008). The within-setting semi-structured interview was conducted with the class teacher and library teacher since the purpose was to seek elaboration or explication on specific activities or interactions as they unfolded in the classroom.

Depth Interview

The depth interview format (Miller & Crabtree, 2004) was used to interview the CEO and Founder of the school for three reasons. First, this type of interview is well suited for respondents who are familiar with being interviewed and who will be comfortable taking control of the flow of their responses. Second, this interview type facilitates the asking of a limited number of "grand tour" questions revolving around broad themes and eliciting detailed, deep responses from the participant. Grand tour questions are useful in asking participants to "reconstruct a significant segment of an experience" (Seidman, 1998, p. 69). Third, depth interviews allow for the setup of a dialogue between the researcher and researched, which assumes a shared understanding of an issue (in this case, one-to-one computing for primary school children from socially-disadvantaged backgrounds). The interview with the CEO focused on eliciting information on the high-level goals of introducing the laptop program, the school's technology-equippedness in general, and the philosophy and mission of the school itself.

Unstructured Interview

The unstructured interview format (Crabtree & Miller, 1999) was used for one interview with the social worker. In the case of the earlier "planned" interviews, a semi-structured interview guide had been prepared ahead of time to help guide the interview process. For the social worker, who was an impromptu participant, an unstructured interview was conducted using open-ended questioning, but also using the interview guides created for other participants as a spot reference for broad issues to cover. The focus of questioning in this interview was not about the laptop since the social worker has no connection with the laptop program. Instead, the aim was to better understand the

students' sociocultural background, as well as the school's philosophy and practices around handling admissions and post-admission daily issues.

Photographs for Visual Analysis

Three separate observation sessions were identified (i.e., three different days during the one month period on site), and digital photographs were taken of the regular activities carried out during the planned OLPC laptop sessions. The first set was taken at the start of the observation period, the second set near the middle, and the third set at the end of the period. The dates and duration of the photograph sessions were as follows:

- Session 1: February 19, 2009 (80 minutes during the block computer period)
- Session 2: February 27, 2009 (120 minutes during the block computer period)
- Session 3: March 17, 2009 (80 minutes during the block computer period)

The reason for spacing out the photo sessions was to see if there were any new types of interactions or differences in activities over the month-long period. Although this was not intended to be a longitudinal study and a month is too short a timeframe in which to expect to see many changes over time, I did not want to discount the possibility that they might occur. In terms of planning what to photograph within each of the sessions, I looked to capture snapshots of important milestones in learning, interactions that stood out, work products created using the XO laptop, emotions in the learning process, and any other motifs that stood out as being important to the community of learners and the teacher. For example, one photograph captured an interaction between two students holding on to and pulling a single laptop quarrelling over who would return the laptop after the laptop session was complete, and the OLPC volunteer mediating the quarrel. There were moments too fleeting to capture, usually expressions or dialogues, and in cases where I missed capturing something striking on camera, I wrote down a description of the moment in my field notes associated with that day of observations.

While over 250 photographs were taken during these three sessions, the total number of photographs analyzed was 123. The photographs omitted from the analysis were the ones in which students "posed" for the pictures, rather than naturally went about their laptop activities. After each set of photo-taking, the photographs were scanned to

check for aspects of the interaction that might need further observation or photo-taking. Often, the photographs from a session provided cues for the types of questions that needed to be asked in an interview or issues that needed to be explored further.

Documents

Twenty-five lesson activities created using the laptop (for example, assignments and informal activities) were collected to understand how the laptop was being used for lesson planning and design (for example, what activities were used and how they were being used). The lesson activities were collected from the OLPC volunteer who handles the planning and download or design of laptop activities. The format of the files was the Open Document Textfile (.odt) file format used for open source word processing applications like OpenOffice, which can also be opened using the Write activity on the XO laptop. The lesson activities spanned two subjects, English and Mathematics. Other documents collected during interviews to support the analysis include the following:

- Long Range Curriculum Plan for Venus Class: 2008-2009
- Sample non-laptop lesson activities in English and Mathematics
- Yuva activities newsletter
- ANZ and Neilsen Group Deep Impact Study at Yuva Report
- Yuva Official Presentation (electronic format)

Data Analysis

Computer Aided Qualitative Data Analysis Software (CAQDAS) was used for the process of data analysis (Seale, 2008). One reason for opting for computer-based data analysis was to help effectively store, organize, and work (Creswell, 2002) with the volume of data collected over the 1-month period. Computer-aided analysis was useful to help manage the data from the various rounds of coding, work with the assigned codes to build larger themes, and group repeating patterns of themes. The qualitative data analysis software used was CleverBridge's Atlas.Ti 6.0. A Hermeneutic Unit (HU) was used as the working file for the analysis, into which all the documents and visuals for analysis were imported as Primary Documents (PDs). 158 primary documents in all were

imported (see Table 3). Both textual data and visual data were analyzed using Atlas.Ti, which allows photographs to be coded similar to regular documents.

Table 3 - Primary Documents used for Computer-aided Thematic Analysis

Primary Document Type	Description
Interview Transcripts	**19 primary documents (textual)**
Observation Notes	**16 primary documents (textual)**
Photographs (from all three photo sessions)	**123 primary documents (visual)**

The supporting documents including the Long Range Curriculum Plan, Yuva newsletter, ANZ and Neilsen Group Deep Impact Study, sample non-laptop lesson activities, and Yuva Official Presentation were not imported into Atlas.Ti for analysis since they were used primarily as sources to understand and depict the social, cultural, and educational context of the school as relevant. Similarly, the twenty-five laptop activities were not analyzed using Atlas.Ti since the purpose was to study them at the holistic level of activity design (i.e., type, structure, and content) and how the activity choice and design related to educational goals and social context. Since the content of the activities was highly subject focused, rather than code the activities at the idea unit level, they were analyzed as a whole in comparison with other activities to look for commonalities or differences in type, structure, and content. The rest of this section describes the thematic analysis procedure of the 158 primary documents.

Coding and Thematic Analysis Procedure

The mode of analysis adopted for this study was a thematic analysis in which iterative rounds of inductive coding were carried out using the constant comparative method (Glaser, 1965; Glaser & Strauss, 1977). Thematic analysis is a mode of analysis in which data is analyzed in a phased, iterative manner to identify repeated emergent patterns (Aronson, 1994). Since this study was concerned with emergent themes, no *a priori* codes were used. Rather, an inductive coding process was followed, letting categories, associations, and themes to emerge from the data. Auerbach & Silverstein's (2003) procedure of qualitative thematic coding was adapted to the needs of this study,

which involved carrying out the coding process in phases. Auerbach & Silverstein's process of gradual abstraction in coding is typically associated with a grounded theory approach, but can also be valuable in conceptualizing the emergent transition from granular data to reported assertions.

While only I conducted the data analysis at the granular level since the immersion in the context was integral to interpretations and inferences, I carried out a peer debriefing process which involved discussing the emergent findings from each phase with my senior supervisor in separate touch-point meetings. This process was valuable in that it raised questions for further exploration in subsequent phases, contradictions that needed addressing, as well as alternative explanations of members' meanings. It served as a process of theoretical triangulation (Denzin, 1970) to better understand the patterns emerging from the data using more than one interpretive position.

Phase 1: Identifying Relevant Text from the Data

The first phase involved going over the 158 primary documents in Atlas.Ti to identify "relevant text" (Auerbach & Silverstein, 2003, p. 37). This involved a line-by-line reading to identity each unique segment of information in the data. The unique segments (which could be a phrase, sentence, group of sentences, or a passage) were each assigned a textual descriptor summarizing the idea being portrayed. For the visual data, a similar process was followed, wherein each photograph was marked with one or more textual descriptors capturing interesting interactions or symbolisms embedded in the visual data. The coding feature of Atlas.Ti was used to create the textual descriptors. At the end of this first phase, 1059 units of relevant text in the form of textual descriptors had emerged. Some text segments from the primary documents were not assigned a relevant text descriptor and were omitted from the analysis. The reason was that such items dealt with issues outside the scope of the school activities and laptop program such as personal interactions between people that were not relevant to the analysis.

The length of textual descriptors was not limited. Rather than using short phrases at this early stage, detailed descriptor sentences were created in order to be as specific as possible about the idea or concept associated with the text. For example, one descriptor

representing an excerpt from an interview read as, “Other class children were disappointed, curious, hurt when Venus got laptops”.

Phase 2: Coding the Relevant Text for Repeating Ideas

The second phase involved coding the relevant text for “repeating ideas” (Auerbach & Silverstein, 2003, p. 37). The 1059 textual descriptors from the 158 primary documents were generated into an output file using Atlas.Ti’s report generation feature. The output file was then saved as a new file (in rich text format) and imported into Atlas.Ti as an additional primary document for further analysis. Using this new primary document as a base, Atlas.Ti’s coding feature was once again used to analyze the textual descriptors. As a new idea emerged, it was marked using a new idea descriptor, and if the idea came up again, an existing idea descriptor was assigned to it. Even if only a part of the relevant text descriptor contained a new concept, it was marked as a new idea so as not to lose any key ideas at this stage of coding.

In this manner, the relevant text units were assigned one or more “repeating idea” descriptors. As with the first round of analysis, some relevant text units were omitted from analysis. These tended to be declarative pieces of information about the school environment and policies, and were used where relevant in this work to set up the context of the school. An example of an omitted descriptor was, “Children admitted to UKG are in the 4-5 years age group”. At the end of the second phase of analysis, 553 repeating idea units emerged. While the earlier relevant text descriptors from phase one were aimed at granularity, the repeating idea descriptors assigned in this phase were broader. A sample repeating idea descriptor was “Confusion with content of laptop task often slows/inhibits children's use”. At this stage, the level of broadness was enough to be able to start discerning patterns from the 553 repeating ideas. All the ideas were carried forward to a third phase of analysis.

Phase 3: Exploring the Repeating Ideas for “Pattern Codes”

In this third phase, rather than use the CAQDAS, a paper-based card sorting exercise was carried out (eg. Wolcott, 2008). The reason for doing this was to be able to visualize the entire data at once and be able to move repeating ideas around to create or

grow emerging patterns while still maintaining the visual display of the whole. The 553 repeating ideas were printed and cut up into physical paper strips. Starting from the first one, the strips were laid down one by one, with a new stack created for each new pattern that was seen. Within each of the stacks, the strips were laid out so that each one was visible, rather than as a true stack one above the other. When all 553 strips were laid down into stacks, the stacks were given a name or "pattern code" representing the pattern the various repeating ideas depicted. Being consistent with the earlier nomenclature, the codes were written out descriptively rather than as phrases but referred to multiple occurrences of the repeating ideas. For example, one code read, "The class teacher finds a tension between learning the laptop versus covering her subjects". The descriptive approach to writing pattern code labels was necessary to capture the richness of the patterns as they emerged.

At this stage, the 553 strips had been condensed to 72 stacks (with 72 corresponding pattern codes). Two of the pattern codes were omitted from subsequent phases of analysis. One of these was omitted because its strips contained descriptive data about the site such as the number of children in the school, attendance rates, number of children admitted, and so on, which were not really patterns representing the phenomenon but rather informational data. The data from this stack was used in describing the site and context in Chapter 4 of this work (see the section *Site and Context*). Similarly, the second stack was omitted as it contained data about the students' sociocultural background and family history. This data was again used as background information to set the context of the site and participants in this study. Seventy unique pattern codes (representing the 553 repeating ideas) were thus carried forward to the next phase.

Phase 4: Exploring the Pattern Codes for Themes

The fourth phase of analysis involved working with the 70 pattern codes to explore whether broader explanations or interpretations of day-to-day member actions and meaning-making processes were evident. A second paper-based sorting process was carried out similar to Phase 3. The 70 pattern codes were cut into strips similar to the 553 repeating ideas from the previous phase. The 70 codes were then arranged in stacks one

at a time, with a new stack created each time a code did not fit into any available stack. No codes were omitted at this stage (i.e., all the codes were assigned to one stack or another). Of course, the number of codes associated with each stack varied. Considering each stack as a unique theme, a total of 16 themes emerged. The themes represented the highest level of abstraction of the data at this stage. They were broad enough to represent the most common or striking characteristics of the laptop program at Yuva at a holistic level, yet concrete enough to represent granular expressions of meaning.

At this stage, I went back to the research questions to explore how the themes spoke to the questions being asked. The research questions focused on exploring how access, expectations, and instructional use of the laptop looked like on the ground. The number of themes that addressed each research question varied. Six themes encapsulated how access to the OLPC laptops was enabled and regulated, seven themes related to the stakeholders' expectations around technology and the OLPC laptop, and three themes related to instructional practices and learning with the laptop. All 16 themes are reported in Chapter 6 in alignment with the specific research question they address.

Memos

During the processes of identifying relevant text, repeating ideas, codes and themes, memos were created using both the Memos feature of Atlas.Ti as well as in a personal handwritten journal to document to process of analysis and make more detailed notes on specific quotations or codes as required. Freestanding memos in Atlas.Ti were used for generic notes not associated with particular excerpts in the data.

CHAPTER 5 — RECONSTRUCTING THE FIELD EXPERIENCE

In Chapter 4, I presented the micro context of the school site and introduced the key participants. In this section, I further aim to bring the reader into the field as I experienced it by providing a richer experience of the Venus class environment as well as laptop sessions. The first part of this section briefly outlines the school environment and atmosphere as well as the Venus class routine to lay out the context of observations and interactions. The second part of this section provides an episode of a laptop session.

Based on the idea that "telling about a person's traits is never as effective as showing how they live" (Emerson, Fretz, & Shaw, 1995, p. 79), I chose to characterize the participants by depicting how they engaged with each other in their natural setting. Thus, I picked the narrative form of the "episode" to represent the field in movement over time (rather than statically). An episode is useful to unfold the sequence of events over a brief period, allowing us to see actions and interactions as they are interlinked and contingent (Emerson, Fretz, & Shaw, 1995). The focus in creating this episode was to explicate the natural chains of events that characterize this site and vividly depict the atmosphere of the Venus classroom. At the same time, I recognize that this episode is not simply a direct capture of a lived experience. Like Emerson, Fretz, & Shaw (1995) point out, the process of writing field notes is not a direct portrayal of a "reality" but rather, the researcher's "version" of events. From this viewpoint, events, interactions, and statements are filtered through the researcher's own assumptions and intentions, which influence what is ultimately represented or highlighted. However, the value of the episode is in the sense of detail that it conveys to the reader who visits this particular field only through the lens of this work. In that sense, the episode provided is meant to help put the findings into context. The format used closely follows the observation field notes from the selected session, with details expanded wherever required to provide context. The laptop session to portray was selected based on whether it would depict the common types of interactions and activities witnessed during such sessions.

School Layout and Atmosphere

The Yuva school building is divided into three main functional areas: the front-facing administrative wing, the central common areas, and the rear academic wing. The Venus classroom is located along the main spine of the academic block, an open corridor that connects all the classrooms and the staff room, and from which each class can be accessed. On entering the corridor, the sounds of children talking, playing, or reciting, or teachers talking to their class are constantly heard. The fact that the corridor connects the main academic areas of the school makes it a major hub of activity through the day. Children sit outside completing unfinished homework, go to drink water at the entry end of the spine, and engage in interactions with the principal and teachers as they leave and return to their classrooms. Apart from teachers and students, volunteers are commonly seen in the academic area, working with classes or groups of children. As well, the principal conducts an informal corridor activity for one class each day using a chalkboard placed in the corridor. Hence, movement and sound are a constant part of the setting. As visitors, teachers, and volunteers walk through the school and the main corridor, children often watch curiously and greet them. For instance, many children walked up to me asking what my name was, whether I was a teacher or volunteer, and where I am from. Once I had met particular children, they remembered me on subsequent sightings and greeted me with familiarity. Children whom I worked with in the Venus class even fell into the habit of accompanying me to the bus stop after class or walking together with me to a common point of divergence. This gave me the impression that interpersonal relationships between children and adults at Yuva were not based on fixed rules or boundaries of interaction, but emerged more naturally.

Class Routine

Students arrive at school by 8 AM, and are provided with breakfast and protein malt at 8:10 AM. The University of Illinois sponsors a program called the Soybean Research Project, which focuses on enriching the breakfast provided with soybean granules (Yuva Newsletter, 2008). Following breakfast, all classes of the school congregate for a short assembly, and by 9 AM, students return to their classrooms. Between 9:00 and 9:30 AM, all classes engage in a silent reading program called the

Uninterrupted Sustained Silent Reading (USSR) program, which has been used in schools in several countries as a way to encourage the development of skills and interest in reading (Yuva Newsletter, 2008). Reading cards with reflective question prompts are distributed to the children for use during this slot. The 9:30 bell signifies the start of the subject timetable and children hand in their reading cards to the class teacher. The second standard class has a fixed weekly timetable of class periods as shown in Figure 3.

Figure 3 - Second Grade Class Weekly Timetable

	9:30-10:10	10:10-10:50	10:50-11:30	11:30-12:10	12:10-12:40	12:40-1:20	1:20-2:00	2:00-2:40	2:40-3:20
	1	2	3	4	Lunch	5	6	7	8
Mon	Eng	Eng	Story	Kan		Math	EVS	PE	Music
Tue	Eng	Eng	Art	Art		PE	EVS	Math	Kan
Wed	EVS	Eng	Math	Yoga		Kan	Math	Eng	LS
Thu	Eng	Music	Math	Comp		Kan	EVS	PE	Kan
Fri	Eng	Eng	Comp	Math		Lib	EVS	Kan	Story
Sat	Math	Kan	Eng	Eng					

* Eng=English, Kan=Kannada, PE=Physical Education, Lib=Library, EVS=Environmental Science, LS=Life Skills, Comp=Computers

The timetable includes both lesson periods such as English, Math, Kannada, and EVS, as well as extra curricular activities such as physical education, music, computers, art, life skills, and story classes. The breakup of subject to non-subject activities is as follows: 68% subject classes (30 out of the 44 periods) and 34% extra-curricular classes[5]. Lunch is provided by the school during the lunch break, as also a protein drink and snack at the end of the day after the last class period. The computer periods in the timetable were originally designed for computer-based exploratory activities in the computer lab.

Episode Reconstructing a Laptop Session

This section provides an episode of a laptop session involving the Venus class. The context was the laptop activity on one Wednesday morning, and the episode captures events and exchanges that took place during this time.

[5] Non-academic activity periods are referred to with the label "extra-curricular activities" in India, comparable to the usage "after school programs" in K-12 contexts.

10:10 AM: The Venus class children have brought in the laptops from the virtual class to their classroom. Twenty-three laptops are stacked in three piles on the bench in front of class. The class teacher, Lalita, is already in class and the OLPC volunteer, Veena, has entered class too. The class remains noisy. The laptop session has started a little later than usual today since the children were given a math test that ran the entire first slot of the block period.

> Lalita: Veena, make minus five [points] for both A and B group. Write it there [gestures to the board where she has a scorecard for the two sides of class set up from the math test from earlier].

The children temporarily become silent and sit down in their places. However, this is not for long. The noise levels pick up again and children begin to move around despite Veena attempting to call out for order. Veena's voice is soft, however, and her affable personality makes it hard for her to restore order.

> Veena: Sit with your partners (louder and more insistently).

Some children start to move while others stay seated immersed in conversations or activities they are engaged in.

> Lalita: Veena, if they don't sit then leave it.

> Veena: No laptop for them.

> Lalita: Veena, those who have settled, sitting with their partners, you give them. For others, they won't get.

This carrot-and-stick approach restores silence. Today, the children share laptops in assigned pairs, which is usually the case during laptop sessions. All thirty-two children are present. Veena distributes the laptops, asking the children to wait until she gives them instructions before they do anything.

Children: Akka[6], we finished akka [referring to switching on and booting the laptops].

V: Wait for it to fully boot. Don't open anything. I will tell. You have to see the board first.

Veena draws out a matrix addition problem on the chalkboard. The children are asked to add numbers along both the horizontal and vertical axes and enter their answers in the rightmost and bottommost cells of a matrix.

1	4	
3	2	
4	6	

Veena answers doubts and once they get the idea, asks them to open a file on their laptop called *AdditionPuzzle2*.

Veena: If it [the file] is not there, I will come and copy for you.

The children start to navigate to the journal view and open the file, which is created using the *Write* activity on the laptop. By this time, it is 10:40 AM and thirty minutes of the period are over. One pair is navigating through the entire list of events in the journal up to two months ago looking for the file. Another girl is helping a boy open the file after getting her own open. [Bhuvan] is following another child (Neeta) around the class, trying to copy her answers.

Neeta: Veenakka, see this boy, see all of them — they are coming to copy, akka.

Veena does not hear the complaint since she is already flocked by children at the back of the classroom. One girl is sitting back sulking, complaining that her partner [Bhuvan] is not sharing the laptop with her. Some kids are pulling laptops from others or protesting loudly. Others are working productively in pairs. Some have formed groups

[6] The mother tongue of the majority of students in the school is Kannada, Tamil, or Telugu, all of which are South Indian languages. "Akka" in many South Indian languages, means "older sister" and is a term used to respectfully address an older sister. At Yuva, the term "akka" is used by children to refer to all female teachers and volunteers, often suffixed to the teacher's or volunteer's name. The equivalent word for an older brother is "anna", again used to refer to male teachers and volunteers.

and are working in these larger circles. [Bhuvan] accidentally erases a number and his partner tells him that the number he erased was a "5" and he can simply type it back in. He holds down the Shift key with the number 5 and ends up typing a % sign instead. The girl says, "Don't hold Shift." Then he tries again and it works. In this manner, other children work within their groups, helping each other when they run into questions or roadblocks. Some other children still surround Veena trying to get the file copied on their systems (which has not been copied on all the laptops before this particular class as is usually done before other classes). Meanwhile, one girl who has finished the addition puzzle has spotted a new set of sums below it and asks Veena if she can move ahead.

Veena: That is the second sum. You wait. I will explain that afterwards.

A pair of children is simply not cooperating with each other. The girl loses interest after a while. "You don't like using the laptop?" I ask her, since she is sitting around sullenly. "Akka he is not giving". The time is 10:55 AM now.

Veena: All of you stop.

Veena [to me]: It is science period now.

Children are closing down laptops. Some have not completed the addition puzzle yet, while others have moved forward to the next sums.

Veena: Close down your laptops. You have science period now.

Two children are fighting over who will return the laptop they used to the virtual classroom. They both hold on to the handle of the OLPC laptop and pull insistently.

Child 1: Akka said to me [that I should return it]!

Child 2: Noooo she said to me! [Tries to pull the laptop away]

Shubha, the general volunteer who arrived a few minutes ago has to intervene.

Shubha: If you pull like that, it will break down. Here, give it to me. I will take it.

Summary: Patterns of Practice and Interaction in the Laptop Episode

While the episode portrayed was from a single laptop session, it depicted many common work and interaction patterns seen in other laptop sessions too. This section briefly highlights some key patterns seen in this episode. All of these are described in more detail when reporting the findings in Chapter 6.

One recurring pattern seen in this and other laptop sessions was an implicit standardization of routine starting from bringing the laptops to class, distributing the laptops, opening the task files, checking student work, and winding down the session. The day-to-day routine always involved giving children granular instructions on how to use the laptop carefully and go about the task before letting them actually embark on the activity. The episode shows Veena taking on this role of distributing the laptops, giving instructions, checking student understanding, and closing down the session.

In this episode, we see that the *Write* activity was used to create a file containing an addition and subtraction puzzle, which students were asked to finish online. This was representative of the type and structure of laptop activities for both Math and English across other sessions too. The activities assigned always involved using *Write* to list a series of sums, word problems, or questions that children were expected to complete using the laptop. The format was similar to a worksheet except that children worked on the activities online rather than on a printed form. One other common part of the laptop routine not seen in this particular episode (possibly due to the limited time of the session) but seen repeatedly in other sessions was the teachers' practice of asking students to copy down the completed activity from the laptop to their notebooks.

A third aspect of this laptop session (and others) that stood out was the social behaviors of the Venus class children and the methods used by teachers to deal with these behaviors. The atmosphere at the start of the sessions was always vibrant and loud, with children excitedly moving around to look at the laptops even as they were brought to class. Further, as children looked for their assigned partners, the room became a flurry of movement and noise, and teachers could be seen struggling with attempts to restore order and proceed with the session. Teachers often chose to use a carrot-and-stick approach to restoring order, using an incentive-penalty technique to placate the children. During the

laptop activity, children worked at varying speeds, some keeping to their assigned pairs and others moving out to form their own groups. Children often displayed a distinct possessiveness about the laptops, sometimes pulling away with a laptop to work independently especially when they were faster or had a more forceful personality. Even at the end of the session, squabbles were commonly seen between children since they wanted to be the ones assigned to return the laptops to the virtual classroom. In such cases, volunteers or teachers stepped in to resolve conflicts.

Finally, in terms of navigating and using the laptop interface, we see that children seemed mostly familiar with the laptop's basic interface functions such as the home screen comprising the dock to select activities and the options to shift between open activities. They also seemed comfortable with navigating to the Journal view to select the working file for the day. During laptop sessions, I also observed that children were self-learning untaught navigation functions as they were necessary (as seen in the case of the boy understanding the function of the Shift key while working with his partner). The following chapter (Chapter 6) expands on these and other findings.

CHAPTER 6 — FINDINGS

The three central research questions asked how access to the laptops was enabled and regulated, what stakeholder expectations were seen around the laptops, and what instructional uses of the laptops were seen. The sixteen themes that emerged from the thematic analysis were compared with the three research questions to explore which aspects of the laptop program implementation they addressed. Table 4 shows a mapping of the themes in conjunction with the research questions they addressed, as a roadmap for the detailed descriptions that follow in this section.

Table 4 - Mapping of Emergent Themes to Research Questions

How is access to the OLPC laptops enabled or regulated?
• A 1:1 access ratio was desired by stakeholders and showed potential for productive interactions, but sharing was accepted as the norm in terms of practicability • Students did not own the laptops and only used them at school, during fixed hours, and under supervision • Equity issues were important to the school in making decisions about access to the laptops • Limitations in access to power, network, and other infrastructural resources constrained access to the laptops • External dependencies for support, software, and knowledge reduced internal control over planning processes and timelines
What expectations do stakeholders have of the OLPC laptop and what does this reveal about their technological values and identities?
• Exposure to the laptops for below-poverty-line children was seen as value in its own right by key stakeholders • The CEO's views of the laptop were based on its potential for children's development and its synergy with the school's technological identity

- The principal's expectations around the laptop were based on doubts about the ability of technology to motivate students
- The class and subject teachers' expectations around laptop use were based on how they supported subject teaching and their students' individual needs
- The computer teacher's technology values were based on the inherent value of access to the laptops more than the details of implementation
- The OLPC volunteer's expectations around the laptops were based on daily operational capabilities and constraints
- Children's expectations around laptop use were based on access concerns, negotiations and transactions, and processes of discovery

In what ways are the OLPC laptops used for instructional purposes?

- With the arrival of the laptops, children got to use computers more and had greater variety in activities
- A regular few laptop activities were used to design tasks supporting curricular goals
- The degree of complexity and relevance of laptop features seemed to mediate which activities and features were used
- Teachers implementing the program at the ground level seemed to be "routinizing" instructional practices with the laptop

Research Question 1: How is access to the OLPC laptops enabled or regulated?

The first research question asked how access to the OLPC laptops was enabled and regulated, drawing from the goals of one-to-one computing and the OLPC, which aim to provide 1:1 access to laptops for children. For several reasons that will be presented in this section, the goal of providing 1:1 access was not practically realizable in this context. Both external and school-internal factors interacted in complex ways, creating layers of access enabling (or filtering) before children actually had the opportunity to work with the laptops.

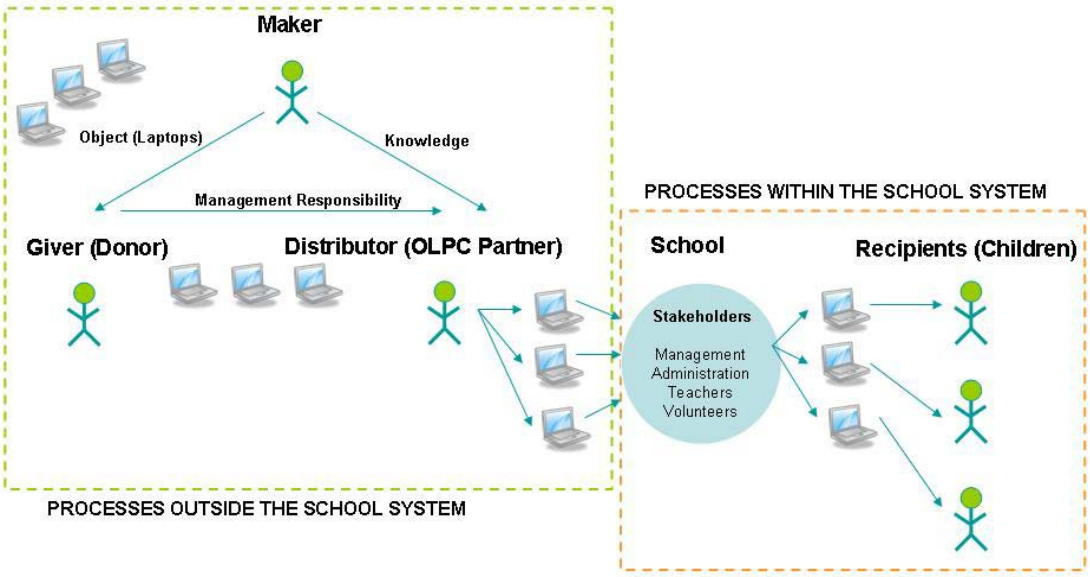


Figure 4 - Access to One-to-One Computing (A Process of Mediation[7])

The various layers of access-enabling fell into two categories: access-enabling processes *outside* the school system and access-enabling processes *within* the school system (see Figure 4). This study only explored the latter, since the specific focus was the school system and the stakeholders within the school associated with the laptop program. The rest of this section presents the school-internal processes, policies, and concerns that explain how and why access to laptops was enabled or regulated. The findings are described with respect to each theme addressing access issues.

A 1:1 access ratio was desired by stakeholders and showed potential for productive interactions, but sharing was accepted as the norm in terms of practicability

In studying how the OLPC laptops were used in the second standard classroom, I observed that 1:1 use of the OLPC laptops only occurred in one of the laptop sessions over the entire month of observations. At the rate of three assigned laptop sessions a week (assuming that no sessions are missed), 1:1 use of laptops by children only represents a very small fraction of the time spent working with the laptops.

Various factors (both external and internal) influenced why 1:1 use was not possible, but the primary one was the non-availability of an adequate number of laptops.

[7] The laptop icons used in Figure 4 are from the Microsoft® Clipart Gallery.

Firstly, while twenty-nine laptops were donated to the school, the Venus class had thirty-two children. Moreover, both teachers and volunteers also needed to use laptops from within the assigned number, since separate laptops were not donated for teacher use. To make 1:1 use possible, there would need to be a single laptop available for each child, and ideally, a laptop for teachers associated with the program as well. A factor that further impeded 1:1 use was the fact that five of the twenty-nine laptops could not be used due to technical problems that were unable to be resolved. This reduced the number of available laptops to twenty-four, which made sharing inevitable when all students were present in class.

> ... Another challenge is that we have 29 laptops out of which 5 are not working. So the kids have to share the laptops. That's why we use partners in the classroom activities (Veena, February 20, 2009).

Working within the constraints of the limited number of laptops, teachers had devised a system where pre-assigned pairs of two children shared a laptop. At the start of each laptop session, children were asked to find their respective partners and move over to sit together. Observations of the classroom during the sharing sessions revealed some difficult social dynamics. When children shared laptops in pairs with assigned partners, some unproductive behaviors and squabbles transpired over who got to hold the laptop, who typed the answers in, and how the laptop was used. The squabbles meant that less time was being spent constructively using the laptop as a learning tool. As well, some children ended up spending time sulking about a squabble and not re-engaging immediately in the ongoing task. The class teacher and computer teacher associated with the program pointed out that children frequently expressed the desire to be personally engaged with the laptop. This manifested in the form of distinct ways they asserted "me-time" with the laptop when working in pairs.

> They are small, no? They can't sit still. So when they are sharing, the other one presses some keys while one is typing. Then they will fight or ask [the OLPC volunteer] to fix it (Lalita, February 27, 2009).

> Most of the time it [the 1:1 use of the laptop] doesn't happen like this. They are sharing. So while one is doing the other is just watching or distracted and troubling others. With one laptop, they feel motivated to

> finish independently and even get competitive, wanting to finish first or correctly (Munira, February 27, 2009).
>
> They all very much enjoy the laptop. The problem happens because they have to share the laptop. Then some children will get to use more, some children will distract, some will get bored. But on the whole, they all very much want to play with it (Munira, March 05, 2009).
>
> They don't want to share. We only have twenty-four laptops now. Five are not working. We have to share with the children in partners. Most of them don't agree with others. They are not interested in seeing their friends coming and telling them something. They don't want to share. They only want to say, 'Akka, I did it!' and get credit (Munira, February 20, 2009).
>
> I guess even if I was a kid, even I would not like to share. They like to do it individually and get credit for it. It is difficult for the teachers when they share but worse for the children (Munira, March 05, 2009).

Since children had to share laptops for the majority of sessions, teachers were faced with recurring ground-level implementation challenges around classroom management. Spending class time addressing these frequent issues seemed to reduce the extent of individual attention teachers were able to give to students in terms of monitoring their learning process with the laptops.

> Through sharing experiences with [the class teacher] I learnt they found it very difficult to share. I also spent some time asking them [the children] about it. They have to learn to share and we have to teach them (EVS teacher, March 04, 2009).

Teachers and the principal often resorted to using a "carrot-and-stick" approach to enabling and regulating laptop use in order to restore order in the classroom, particularly at the start of the sessions when children had been asked to find their partners.

> Veena, those who have settled, sitting with their partners, you give them. For others, they won't get [the laptop] (Lalita, March 04, 2009).
>
> Venus class teachers, when they are misbehaving, they have one advantage, they can say 'no laptop' and the children will behave (Munira, March 05, 2009).

> [The management] has told that if you do the laptops very well and become very good, then you can even take the laptops home… [The children cheer and ask if they will get to take them home now]… No, absolutely not now! Only after you become very good. Now remember, that Veena is also a volunteer for computers and in the other school she teaches in, the laptops are used by 6th standard children. She is going to teach you all the same things, till you go to 6th standard... (Priya, February 20, 2009)

One exchange that took place between the class teacher and children before the start of a laptop session seemed to best represent why the carrot-and-stick approach came to be followed. It seemed to be a preventative expectation setting measure that teachers felt the need to adopt in order to make clear the consequences of distracting or negative behaviors to potentially avoid these behaviors. This practice might have evolved because even with three adults in the classroom during laptop sessions (the class teacher, computer teacher, and OLPC volunteer), it was clearly difficult to handle the noise levels, constant movement, and children's tendency to seek help all at once instead of waiting their turn.

> Lalita: Now children, the ones who behave well will be given laptop. Others will not get anything.
>
> [Instant silence]
>
> Lalita: And once you go there, you have to share, no fighting or quarrelling… And you know, no once you type the first sentence, the second sentence will be typed by friends.
>
> Children: Yes akka… Yes akka (a chorus of them).
>
> Lalita: You have to sit there with your partners. When you go there, go in a line with your partners. You have to follow the instructions. Don't press the buttons that you are not asked to press.
>
> [Silence and several nods. The children look like they cannot wait to get started.]
>
> Lalita: Okay children, now I will give you the test - you have to write. After you write and submit, I will make you to stand outside [to go for the laptop session] (From observations on February 20, 2009).

While even non laptop sessions posed classroom management challenges, one adult in the classroom was always more than adequate to restore order. The only other sessions that showed similar dynamics to the laptop sessions were the block art periods where new art supplies were usually distributed to children (eg. paints, brushes, glue, chart paper) to share. Again, having to share supplies and wait for others to finish before being able to access and use them seemed to make many children impatient and prone to unproductive behaviors like complaining, snatching supplies from others, fighting to gain maximum use of the supplies, and losing interest in the task. This seems to indicate that children were eager to independently express their ideas. In addition, when activities involved the use of one or more tools that children did not typically have access to in their daily lives, they tended to be possessive and consciously asserted "me-time" in the only ways they knew how.

When it came to sharing the laptops, while the class teacher and computer teacher found sharing problematic with regard to classroom management, the OLPC volunteer actually stated that she found sharing more convenient. This was possibly due to the added workload she typically had of having to copy the activity files on all systems individually and distribute them in class. Sharing the laptops would reduce the number of laptops she would have to "get ready" for each session. Hence, basic logistical factors could account for stakeholders' preferences around access to computers for children.

> Now they share the systems — previously we gave one each. As long as that is there [sharing], no problem (Veena, March 04, Wednesday).

> Sometimes, the pen drive behaves crazy in this laptops, I don't know why. With this memory, the CD drive is difficult. I load files before only if possible, otherwise, I will do the same day (Veena, March 04, Wednesday).

A key aspect of sharing that the teachers had difficulty with was assessing individual contribution to the task. In many pairs, one child was faster, stronger in the subject area, or more comfortable with the laptop, and consequently dominated the laptop activity. In the completed task, there was no way of knowing how much each member of the pair had contributed to the group effort or what were the weak or strong areas of learning for each child to provide further attention at the individual level.

> There are problems with sharing too. It is easy to evaluate with a single laptop per child but with more laptops, we don't know who is doing the work and how. Plus some dominate the others. In daily assignments, we make the child sit separately and help each child where they need it. Since the motive is to expose them, the shy or weak ones fall behind. My aim is not achieved there — it will not reach there. I believe in no child left behind[8] — we have different abilities so we have to focus on that. There are 33 in a class, and 33 mindsets and ways of learning. We cannot underestimate anybody (Runa, March 04, 2009).

The only time that students got to work on the laptops independently was when there were multiple children absent and multiple others who had not completed their homework and had been sent out of the classroom (to complete the homework before they could take part in class activities again). On one such session during the month of observations, there were twenty-five students remaining in class, and hence children got to use a laptop each except for one pair that had to share the twenty-fourth laptop. When they had their own laptops, children voluntarily congregated into pairs or groups (i.e., working together, alone) based on mutual interest or speeds of working. While working in assigned pairs on the other hand, children complained about their partners when they sensed that the other child was getting to work on the laptop when they were not. For instance, one boy's complaint about his partner jumping to the games first and a second girl's complaint about other children trying to copy from her were typical of the sharing sessions with the laptop:

> You should write this in class work [the class work notebook], no? See this girl didn't write. She went to *Memorize* [a laptop activity only allowed after completing the assigned task] (Arif, February 27, 2009).

> Akka, see this boy, see all of them - they are coming to copy akka (Neeta, March 04, 2009).

When explicitly asked about their preferences for sharing or independent use, children communicated that they enjoyed sharing even though they also clearly seemed to enjoy having a laptop of their own to work with (as observed in the one 1:1 use session

[8] Runa uses the phrase "no child left behind", but as is seen in this context, she is not referring to the No Child Left Behind (NCLB) federal legislation in the United States but more simply to the idea that she does not want any learners to fall behind others.

where the unproductive social dynamics seen in sharing sessions were considerably fewer and children spent more time engaged in the actual task). Their reasons for liking to share the laptops were twofold: first, sharing helped them to learn more; and second, it gave their peers an equal chance to use the laptops. The latter rationale was more commonly expressed. For instance, when asked whether they liked to share the laptops, the reasons given for liking to share were primarily based on equity concerns. The low socioeconomic background of the children might explain this, since many children (despite their young age) seemed very aware of the feeling of *not* having something and clearly wanted others to experience the same delight they did in having it.

> Yes akka, I like to share. Because my friends will not have laptops means I will give akka (Arif, March 12, 2009).

> I want to share with my friends because they are our friends and they also want to work with laptop. [Who, all of them, I ask]… That boy, Anand, is my partner (Neeta, March 13, 2009).

> I like to share with friends. Akka selected one girl for me - Sunita… If they share, I will also share (Raj, March 13, 2009).

> Yes, akka. Share also, alone also. Share because my friends also need to play with that (Amir, March 13, 2009).

> I use the laptops with friends and alone, akka. I share with Manu. Because we have less laptops, that is why (Pradeep, March 13, 2009).

> I like to share because I like to learn more (Sheba, March 11, 2009).

Students did not own the laptops and only used them at school, during fixed hours, and under supervision

Apart from a 1:1 ratio of access, an important goal of one-to-one computing in its most ideal form is to provide children ownership of computers to allow them to take charge of their own learning and provide the unrestricted opportunity to develop technological literacies (eg. Grimes & Warschauer, in press; Penuel, 2006). However, similar to the constraints preventing 1:1 access, ownership of the XO laptops did not translate into practice at Yuva. The school's decision was to maintain the laptops within the school premises and implement a structured program of use. The school consciously

administered the duration, frequency, and times of using the laptops. This section describes the rationales that underlie the regulated access to ownership of the laptops.

The OLPC laptops, though assigned to the Venus class students, were originally given to the school rather than to the children for their own. Perhaps due to this, the laptops were kept in school, secured in the virtual classroom, and taken out for use during assigned laptop sessions during the week. Stakeholders pointed out that the decision to keep the laptops in school was made to ensure the safekeeping and longevity of the laptops, as well as to handle day-to-day operational aspects like charging.

> We will keep the laptops in the virtual class itself because they will be safe there. Plus we have to charge all, no? I don't know what the plan is for the laptops in the future (Munira, February 25, 2009).

The age and socioeconomic background of the children were stated as the primary rationales for not giving laptops to children to use 24/7 and take to their homes. Due to the lack of family exposure to computers and therefore the lack of knowledge in this area, it was thought that children would not get the support they needed to care for the laptop adequately at home. Considering the nature of slums which lack both space and basic amenities (for example, water and electricity), as well as the school stakeholders' familiarity with the children's homes and lifestyles, this concern might be well founded.

> In future, if we have one laptop for each child, there is no sharing, we will be most effective. [What about giving the laptops to the children all the time to take home?]. No, not now. Our children come from what environment [emphasis]?! So how will they keep safely, change the battery? They don't have power also so they can't even switch it on means what? (Lalita, March 12, 2009)

> So far, no [parents have not had anything to say about the laptops]. But I have heard that Khairat school [the pilot OLPC site in the Indian state of Maharashtra], laptops have been given to the kids and they carry it home and bring that back. But here it is not possible because they are not allowed to carry it home (Munira, March 05, 2009).

> Parents, only if the children go and tell or show them, then they will make out. Here they don't carry the laptop home so no homeworks also we can give (Lalita, March 12, 2009).

During interviews with the teachers, they confessed to not being aware what the future plan was for the laptops and that the management still needed to make decisions. The CEO and principal, however, stressed that they were considering ownership of the laptops by the children, only not at the current time since they felt it was still too early. The CEO hoped to initiate a family orientation program in the future to include parents in the laptop program and give them both the opportunity for exposure and the knowledge to care for the laptops.

> We have plans to call a parent-teacher meeting soon and introduce the parents to the laptop and even allow the mothers to play around with it. Because right now, even if we send the laptops home with the children, the family won't know how to provide the required care for it. By exposure to the laptop, that's how comfort and total freedom comes in (Sarika, February 24, 2009).

An external volunteer only associated on the fringes with the laptop program (rather than with the day-to-day implementation) was in favour of ownership based on her observations of the laptop sessions and interactions with teachers implementing the program. She argued that the laptops *should* be given to children for their own use, pointing out the important potential benefit that the ownership of laptops might help make children more responsible and meta-aware of day-to-day care such as charging.

> I think one issue is that the child doesn't have the laptop and doesn't know the problems that we face. Only when the child gets the laptop, the child is going to know that they have to charge it. If they are not given the laptop, how will they know? (Shubha, February 20, 2009)

Apart from not owning the laptops and thereby not having the ability to use them at home, their use within the six-day school week while greater than before, was still considerably regulated. Laptops were not used all day long during every lesson or even for the majority of lessons. Rather, the use of laptops was limited to about 16% of the time the Venus class children spent in school during the week (see Table 5). The breakup of time for laptop sessions and computers in combination was 18.2% of the time spent in school during the week. Even though that figure seems small, when we compare the time spent on computers overall to the time spent on other subjects and extra-curricular activities, we see that the time allocation for computers was comparable to that for the

two subjects with maximum coverage each week (English and Math). Moreover, a portion of English and Math time was assigned to laptop use. For instance, 36% (or 4 out of 11 classes) of the English classes each week were assigned to laptop use. Similarly, 28.6% (or 2 out of 7 classes) of the Math classes each week were assigned to laptop use. The allocation of comparable amounts of time to the major subject sessions and the integration of the laptops with the curriculum indicated that the school was making conscious attempts to develop a pedagogy around the laptop in alignment with their educational goals and capabilities. Thus, even though the frequency and duration of access to laptops seems regulated or limited in comparison with the goal of one-to-one computing, the school has in reality made purposeful adjustments to the weekly schedule to allow *more* access to computers for children. Firstly, while the laptops could have simply been assigned to the two computer periods that exist on the timetable, the school had altered the weekly timetable to allow for more weekly sessions devoted to computers. There were now seven sessions for computer use as opposed to the earlier two. Secondly, attempts were being made to integrate the use of the laptop with the subject curriculum rather than as freestanding sessions. This indicates that the school was trying to balance the idea of curricular relevance with weekly scheduling considerations.

Table 5 - Breakdown of Time Spent on Academic and Extra Curricular Activities

Subject	Number of hours each week	% of total weekly hours in school
English	11 (includes block laptop sessions)	25%
Math	7 (includes block laptop sessions)	15.9%
EVS	5	11.4%
Kannada (2nd Language)	7	15.9%
Story	2	4.5%
Life Skills	1	2.4%
Physical Education	3	6.8%
Yoga	1	2.4%
Library	1	2.4%
Music	2	4.5%
Computers	1 (non-laptop computer period)	2.4%
Art	2	4.5%

The choice of the English and Math block periods for laptop use was primarily based on convenience: first, the availability of adequate time to set up and close down sessions including bringing in and putting away the laptops; and second, because the block periods belonged to the class teacher (who was familiar with students' individual and collective needs, as well as the Long Range curricular plan for the academic year).

> We wanted to train the children - only for English and Maths we had the block periods. So that happened. It is also easy, convenient to use (Lalita, March 12, 2009).

> First we had decided to use only for the English. We didn't go much in that. We were new in that. So *Write* and *Memorize* [names of software activities installed on the laptop] was used, the ones we learnt as we went along. Veena was new. I was the one who started to do everything alone. After Veena came, then 1 month later [the Information Age Foundation] came with 25 other laptops. When Veena joined me we decided to add more. We go to a website and download activities. We do opposites, plurals, many such activities. Then Math got added. There is nothing like it is only for one or two subjects. It can be used for all. For example in EVS, [a multinational company] had come for safety rules workshop. We gave a topic, they were able to write about it - they were so interested and we saved the work they did. They were able to remember all the safety tips and came up with their own for EVS. Most of the time we just ask the class teacher what they have and want to do. It's very easy doing English in laptop. Plus the class teacher teaches English and Maths so it is easy to do that. In science also we can easily do it. Once or twice, I go into class and see what Runa akka is doing then I can get ideas for what to do (Munira, March 05, 2009).

Another regulation in access to the laptops was that they were always assigned to be used under supervision by adults, often by more than one person (due in part to the classroom management issues reported in the first theme in this section). Observation of the laptop sessions over the month-long period revealed that this seemed to be a reasonable choice by teachers, who all appeared very well acquainted with the children's personalities and special needs. For instance, according to the class teacher and social worker, around 50% of the second standard class children have been diagnosed with disabilities or mental and emotional problems that sometimes result in unpredictable or unproductive behaviors. Some common issues include dyslexia, Attention Deficit Hyperactivity Disorder (ADHD), depression, post-traumatic stress disorders, and violent

tendencies due to living in abusive homes. Rough handling of the laptop, while not common, was also definitely present. For instance, I observed one group of boys in class who were often disengaged from class activities, and who began to distract other children working with laptops or rough-handle their own (eg. during one session, they played a game where they chased each other crawling on hands and legs with the laptops perched on their backs). In other cases, children in the assigned pairs fought over who should return the laptop to the virtual classroom, each pulling the laptop with one hand and pinching or beating their partner with the other. Not so productive behaviors aside, supervision also seemed to be necessary to distribute the laptops equitably, address student questions and doubts, check in-progress or completed work, and handle minor technical issues with the laptop such as hung screens.

Students were not the only ones who had limited access to the laptops. The class teacher associated with the laptop program did not own a laptop either, which could explain her current lack of comfort level with the laptop and preloaded activities. Teachers (the class teacher and computer teacher) and the volunteer associated with the laptop program were allowed to borrow a laptop to take home for lesson planning whenever they chose to do so. However, the basic lack of knowledge about the OLPC laptop and about computers in general might have been factors impeding Lalita's motivation to check out a laptop and design her own lessons.

> I don't have that much knowledge of computers, ya. I myself am only an "L Board[9]" [laughs]. I have not played video games. My children are good in that. So I don't know [laughs again] (Lalita, March 12, 2009).

> Even I am very much new to it [the laptop]. Even I don't know how to use properly. Along with the children, I am also learning... (Lalita, March 12, 2009)

The computer teacher handled any requests for a laptop and tracked their movement using a register. The OLPC volunteer ended up being the only teacher associated with the program who actually borrowed the laptops to plan for lesson

[9] Lalita's use of the expression "L Board" is in reference to the alphabetic board placed on the cars of new drivers in India who are learning to drive. It signifies that the driver is a learner. She uses the analogy to emphasize her own lack of familiarity with technology and the OLPC laptop.

activities. The class teacher seemed to depend on the OLPC volunteer for all laptop-related lesson planning, design, coordination, and implementation. The computer teacher acted as an overall coordinator and facilitator to ensure that the laptops were kept ready and things ran smoothly during sessions. She also stepped in to provide support when required, but like the class teacher, depended on Veena to handle the day-to-day details of lesson planning, file copying, laptop distribution, and laptop collection in addition to handling student queries.

> I just make a record of the laptop movement. 24 laptops are there, who is taking out and when it is coming back. For example, Veena and [the ex-volunteer], the volunteers will sometimes take the laptop for designing lessons (Munira, March 05, 2009).

> Thanks to Veena I am able to do multiple classes together. So I try my best to help her in whatever way I can, especially with charging. She also asks me if she wants to take the laptop home to prepare for lessons (Munira, March 05, 2009).

> I take their [the school's] permission, take one laptop home and use it to prepare (Veena, March 04, 2009).

Equity issues were important to the school in making decisions about access to the laptops

From an internal policymaking perspective, stakeholders confessed to experiencing difficulties in enabling access to the laptops, particularly in making decisions about who got to access and use the limited number of laptops. When the local distributors of the OLPC laptop first brought the laptops to Yuva, the decision was made to provide the laptops to the second standard students. The implications of this decision were that even as it opened an opportunity for one set of learners in the school (in comparison with other learners globally), it also automatically set up an internal inequality in terms of access to technology (and in turn, potentially, in access to opportunity as argued in many digital divide rationales).

> Only Venus class uses the laptops. They were provided for this class (Veena, February 20, 2009).

> We have tried to coordinate with the Foundation that first gave us the laptops to provide both support for the laptops as well as laptops for more

> children. I said to the distributors, 'Look, I have four schools and 996 children. I can't just give it to one class and deny it to the others. I might have to pull it out.' I don't want to talk about equality on the one hand and create inequality among my children on the other (Sarika, February 24, 2009).

Apart from the fact that the children outside of the Venus class missed the opportunity to work with the OLPC laptops, the school had to also deal with the reactions of children who did not get this opportunity. At Yuva, teachers commented that the OLPC project had not gone unnoticed by other children across the school, mainly since it was a very "visible" project at the school. Laptops were seen being transported through the common corridor between the virtual classroom and Venus classroom and children also saw visitors coming in to specifically watch the Venus class work with the OLPC laptops. Children from other classes had expressed both their interest in the laptops and their disappointment that they could not use them, ever since the laptops arrived at Yuva.

> In fact, the OLPC laptop is quite new to us. Long before the laptop, we were running the school. We didn't seek out the laptop. The laptop was given to us as a donation. We didn't go after it. They found us and shortlisted us to give us the laptop thinking it would be a good environment for the laptop to be used (Sarika, February 24, 2009).

> The whole school was affected I think. Children were coming to me and saying 'Akka we are not getting laptop', with that sad face. You can see it in their eyes. When it first came, I had to answer 1000 questions. Earth, Mars, all the classes. When I would walk in the corridor with the laptops they would say, 'open and show it akka'. I felt so bad. They feel like touching it and want to work with it. But if you show it for a minute and they know they can't use it that is also sad. Someway you feel they don't like you. They know the laptops are kept in virtual classroom so they used to come and see it and touch. Sometimes kids would have slowly come in and tried to open the screen with the antenna. You can feel their curiosity and eagerness to learn with the laptop (Munira, March 05, 2009).

A related problem with providing access to just one audience is the issue of how long to provide the access for. Since the OLPC program at Yuva was so new, teachers and administrators were not yet sure what the best course of action was to take vis-à-vis continuing the laptops for the Venus class in subsequent years. The options they thought possible were to send the laptops to future years with the current Venus class, or to keep

the laptops behind for future Venus class batches. Each of the options had a convincing rationale: with the former, the school would be able to promote a pattern of growth in computer literacies using a single, standardized model of computing (i.e., 1:1 laptop use). On the other hand, with the latter, more children would be exposed to the possibilities of mobile computing. If the latter option is selected, the "consolation prize" was believed to be that the current Venus class would still have regular computer classes to look forward to as well as another special activity available just for third standard children. Each class that did not have the laptops had been given one major special activity that was all their own. For the third standard class (Earth), it was swimming lessons. If Venus did not get the laptops when they moved ahead to Earth, teachers thought that the swimming lessons might be an exciting enough incentive to keep learners' morale high. However, in general, teachers seemed to see more value in learners continuing to use the laptops to take their knowledge and skills to the next level.

> … Unless they are provided regularly it will not effect. If you don't continue for next academic year, they will feel bad. Otherwise, they have to go to cyber café to use computers (Lalita, March 12, 2009).

> It should be continued. But one way is other children will also get to experience if we keep it only for Venus class (2nd standard). I don't know what they will do. The management has to sit down and decide (Lalita, March 12, 2009).

> I guess yes [it is a problem to not continue the laptops for the Venus class]. They must be thinking that we must just stay back in Venus class! We should not go to the other class. There will be some changes. They (the management) are thinking about it, so the children, maybe they will take the laptop to Earth, or they might use it for Venus and see the new Venus class with the laptops. It is difficult because it is a choice between whether this class should continue to get the benefits of the laptop or whether more new children should also be exposed to it. I don't know what they will do (Munira, March 05, 2009).

> Today [Terry] anna will take the children to the nearby swimming pool for orientation for next year. Just like Venus class have the laptops, other classes have some special activity so that they won't feel left out. For third class, it is swimming classes (Lalita, February 26, 2009).

Teachers recognized the risk that in discontinuing the laptop, it could be relinquished to being akin to just another toy used for a short time and then taken away, with its learning potential not fully explored. Children might also not get the opportunity to fully express themselves with the laptop independently since the laptops might not be available to them by the time they got comfortable or confident enough to autonomously use it in imaginative ways.

> I am optimistic [about the idea of a single laptop for children]. In this age group it will benefit. It should not stop however. They should continue with it in 3rd and 4th standard. Until the child is independent to create their own creations it should be continued. Else OLPC will be like a toy, they play with it and they leave it. They will play with it in Venus and then forget it (Runa, March 04, 2009).

Lalita, the class teacher had mixed feelings about whether the laptops should have even been provided to children of this age group and socioeconomic background. Mainly, she wondered about the value of introducing and then taking away the laptops, stating that it might set up unrealistic hopes where children might start to seek the use of computers outside school and have to pay for this use with their family's scant resources.

> To be very frank, no, it is no use giving laptops to the children. It should be given to higher classes. When they go to the next class, they will miss the facilities. And even when they go outside, what will they do? Will they have the money to afford a cyber café for 30 rupees an hour? What I thought is that instead of taking the laptop home, let them do their homework properly and come. You might have observed that slow learners are not doing. Because others are doing they will try. But they are not really interested (Lalita, February 25, 2009).

Limitations in access to power, network, and other infrastructural resources constrained access to the laptops

Studies exploring the use of technology for development in developing country contexts often highlight the challenges of limited access to power, bandwidth, and other basic infrastructure (eg. Pelgrum, 2001; Chandrasekhar & Ghosh, 2001). Often, this is because of the remoteness of sites from city centers or the rural settings they are based in. While Yuva is neither a rural nor a remote site, and in fact is located in a central part of the city, it still faces some infrastructural challenges that are inevitable in the context of developing countries. These include unscheduled power cuts during seasons of electrical

load shedding or monsoon storms. Further, there is no school-wide wireless Internet setup. Broadband cable-based Internet is still the popular choice of Internet services in India since wireless connectivity is still expensive mainly due to the lack of an ubiquitous wireless infrastructure.

> We have no wireless here. We have Internet on the cable (Veena, February 20, 2009).

In the month that I spent at the school, the power unexpectedly went off at least three times, which would not typically hinder a regular classroom setup but would definitely have an impact on computer classes, laptop sessions, and virtual classroom sessions if it occurred during such times. Of course, one factor that ameliorated this risk at Yuva was the fact that the laptops were used on battery power due to the lack of power outlets in the classroom. However, in the eventuality that the school wanted to consider extended usage of the laptops on a day-to-day basis using power supply, this might be a problem. Limited school resources due to Yuva being a non-profit organization could mean that investing in a generator and its ongoing upkeep would be a luxury cost. Similarly, with the Internet, Yuva was similarly equipped to other Indian schools in terms of the overall availability of the Internet to students, which in general tends to be quite limited except in elite private schools. Expecting a non-profit organization to invest in school-wide wireless infrastructure when they are working month-to-month to meet basic operating costs to provide free education, food, and healthcare to more than a thousand children is putting them in the difficult position of having to clarify their priorities. Understandably, their priorities could be more foundational.

Other infrastructural challenges were more localized within the school site itself such as the limited number of power outlets available in each classroom and even in the school's technology "hub", the virtual classroom where external power units were connected to the limited wall outlets. The Venus classroom had only one main power outlet located at the back of the class at a height that students could not reach (about six feet above ground). The lack of ample power outlets in the classroom made it a less than optimal environment to use the OLPC laptops. Yet, the laptop sessions were still held in the classroom and teachers worked around the issue of lack of power outlets by fully pre-

charging all the laptops that would be used at each session. This put a tremendous responsibility in the hands of the computer teacher who was tasked with getting all 24 laptops completely charged and ready for each of the three weekly laptop sessions. Typically, this might not be such a cumbersome task if there were enough outlets to charge all the laptops at once. However, since the virtual classroom also only had a limited number of outlets that could be used as charging docks, this meant that on Tuesdays, Thursdays, and Saturdays, the computer teacher spent a large part of her day setting up batches of laptops for charging, checking for completeness, and rotating the batches once they were done. Added to this, there were practical problems that came up while charging such as the charge indicator light not coming on or laptops not working once removed from the socket after they were fully charged. When such situations came up, the computer teacher and OLPC volunteer typically set aside the laptop from the others and continued with the remaining machines.

> One challenge you know, is the charging of the laptops. After every use, we should charge them but we can only charge five at a time because we have that many slots. It takes two hours to charge each one. So we have 24 working ones, we have to do it in five batches. The computer teacher has to remember to charge the others and rotate them, otherwise that's all. Especially on the weekend, if she forgets on Saturday, Monday no laptop can be used (Veena, February 20, 2009).

> One big problem I am facing, we have two sessions (or three max) mostly where we give the laptop to the child. After the sessions we have the problems charging it. Sometimes, there won't be power (Munira, February 20, 2009).

> Each laptop takes two hours to charge. Munira does it. Two laptops have technical problem — you take it out of the socket, it doesn't work (Veena, February 20, 2009).

> Sometimes I feel [bad that] I have to depend on Munira for charging (Veena, March 04, 2009).

> The other bad thing is definitely charging. The first point is that I have to put that [the computers to charge] — it's killing me [laughs]! Alternate days class, as they finish, I put it in charge or it will never get done (Munira, March 05, 2009).

An unexpected challenge to the use of technology at Yuva was also the inherent limitations of technologies and the environments of their operation. For instance, the LCD projector located in the virtual classroom was used for videoconferencing and also for the movie sessions during single computer periods. Projector equipment is known to get heated up very easily. This would matter less if it were being used in an air-conditioned space, but the virtual classroom where it was located, like the rest of Yuva, had a light-weight roofing structure that let in considerable amounts of heat especially in the hot summer months. On one such day that the movie session was in progress, the projector started to act up. When the projector first started to falter, the computer teacher got up to reposition it and directed the standing fan at it with the hope of cooling it down. However, after a few minutes, it died out altogether. When the projector burned out, the computer teacher Munira was supervising the class. Since the burnout occurred in the last ten minutes of the class slot, she chose to use the time just to restore order and get the children ready to line up to move to the lunch room.

External dependencies for support, software, and knowledge reduced internal control over planning processes and timelines

Even though the laptop program had been running at Yuva for almost six months, I noticed that much of the current knowledge and expertise on the laptop seemed to come from *outside* the school system (for instance, from the OLPC volunteer or the Foundation that distributed the laptops), as opposed to staff within the school. Tracing the origin of the OLPC laptop program at Yuva and the important milestones in its implementation illustrates these external dependencies on many levels including for technical training, ongoing knowledge and pedagogical support, technical support, and software upgrades. The laptop program officially began in June 2008, even though laptops began to be used regularly with the curriculum only by September 2008. The laptops themselves were designed and developed by an external party (the OLPC), funded by another external party (a Dutch couple), and distributed by yet another external party (the India-based Foundation) before they made it into the school system.

> The funds were raised by a Dutch couple who have been working on raising funds for OLPC for a while. The laptops were distributed through

> OLPC's partnership in India - by the Information Age Foundation (Sarika, February 24, 2009).

> It started 8 months ago around June/July. When they gave us, only we had got 5 laptops first. Those five were given to the teachers to get familiar. We were trained for one full day. Then there was a gap for 5 full months. Then they came back and gave 24 more laptops to make it 29 in total (Munira, February 20, 2009).

When the laptops were brought in by the Foundation, they also provided a one-day training session to the core Yuva staff who were to be associated with the program, namely, the computer teacher, Munira, and class teacher, Lalita. The class teacher of the third standard class also attended the training session presumably because Yuva had taken into account the scenario that the laptops would be sent up with the current Venus class batch. The nature of the training was basic, focusing only on the features of the laptop, which the stakeholders initially thought helpful (due to their own newness to the interface) but belatedly perceived as not having provided value in terms of helping them utilize the laptops creatively and effectively within the local curriculum.

> When the OLPC was first given to us by the Information Age Foundation, they gave us a one-day training session. It was enough support to get running with it of course. But we need to take it to the next level (Sarika, February 24, 2009).

> I joined only in August 2008. The laptops came long ago — six to seven months ago in the beginning of 2008. No one knew how to manage it. From September, Anand and the team from Information Age Foundation came and conducted a session (Veena, February 20, 2009).

> In the training they focused on features of the laptop. For example, music. In science, social science, we can have music and all. If the Africans are there, how to create that music using TamTam Jam (Munira, March 05, 2009).

Even with the walkthrough of the laptop features that teachers were given, the coverage was broad rather than deep. Thus, teachers were able to develop a sense of the various activities on the laptop but in terms of actually learning to use the more complex applications, the initial training was purported to be far from adequate. Both the computer teacher and class teacher pointed out that the initial training was only just a beginner's

orientation to the laptop and that further training for teachers is required to extend its use to the next level. While Munira felt the need for technical training with the laptop rather than training on how to use it educationally, Lalita felt the need for both since she stated she is unfamiliar with computers in general as well as with the OLPC laptop's vision and philosophy in particular.

> Yes [I was a part of the preliminary training given about the laptops]. He didn't tell us what we can do. He showed us, see this is there. Write is there similar to Word, Memorize, Turtle, Paint, Camera, Sounds. He showed us activities. He might have thought this is the basic, starting that we must know (Munira, March 05, 2009).

> The philosophy [of the OLPC laptop] I don't know. During the training day, the first day, they said these are the facilities. In the classroom, they said each child can have a contact through the laptops but that thing I could not make out. We are not using it also. Moreover, that day, we spent two to three hours only not the whole day, Me, [the third standard teacher], and Munira attended. Anand and Susan provided the training. The very first day they brought the five laptops there were many people but I don't know who — hardly I know. The laptops were given to Venus class. That is why they took me for training (Lalita, March 03, 2009).

> I told you, na, *nothing* they covered. Nothing training was there. Two days we sat half, half a day and they showed camera system. This is what the chat system is, like that. We couldn't understand it — it was very much new to us. Enough training we didn't get (Lalita, March 12, 2009).

> This is one big challenge I am facing [not knowing how to use many of the laptop activities]. I have not even touched many of the other applications because I don't know how to use and where to start (Veena, February 20, 2009).

> So far I didn't feel [that I need more education-specific training with the laptop]. If they [the OLPC] have something advanced that I should learn, then yes, I am ready. Something new or extraordinary we should have one or two sessions. Turtle etc., Venus is too young, higher classes can do it. I think I don't need training at this point. If teachers are interested, we have to train them. But I feel Lalitakka is done with it. Also if Veena is not coming, we have to be able to handle it (Munira, March 05, 2009).

Lalita and Munira had different views on who should arrange or provide the training. While Lalita believed that Yuva was responsible for taking the initiative to

arrange teacher training to effectively use the laptops, Munira felt that it was the responsibility of the maker, or if they were unable to provide it directly, that designated experts should provide the training.

> It is Yuva, na [that should address training]? To improve this, we have to take care. We should take the initiative to contact, show interest, so they come to help us. But one thing, though we need or not, here [at Yuva] they will give more than what we need. In no other school I have seen this much. Only in Yuva, they give more than we need. Unless we know to handle, we can't answer, so yes, some training is needed (Lalita, March 12, 2009).

> I guess the person who has made the laptop [should be the one to provide the ongoing training for it]. He will know a lot. If he can't come, someone who is using it and knows about it. I am not saying Anand [from the Information Age Foundation] has not done his work. We need training on the educational side of the laptop (Munira, March 05, 2009).

While Lalita's view above might suggest that Yuva does not have a professional development program or does not focus much effort on teacher training, this is not the case. In fact, Yuva's teacher development program is detailed and includes a variety of activities annually to support teachers in their subject teaching practices as well as in working with a vulnerable population. Lalita stressed that the program is thorough and unlike any other she had been exposed to in other schools.

> Every year, we have eight days of orientation. The school will take us at the beginning of the year to the places where the children live to understand their background, and the other three branches [of the school]. Once we know their background, we know practically how to handle them. They show all the four branches for all the teachers. No school is providing so much training all for the teachers. Here, they take care of the teachers. For example, we had this EDUCAMP — how to use modern teaching aids every Saturday for one full year. After school on Saturday we had to go for one full year. It was tiring but very detailed. We also have MULTILIT program where they take the child and help them to read, like reading tutors. Then we have a special educator. We will give a list of children who have problems. They take them out and find out what is lacking, counsel the children, and give feedback to the teachers on how to handle the child. Then today, we have an eye check-up camp for the children. Yearly, they have dental and physical checks ups, free of cost. They also give the medicines free of cost. We have a separate fundraising

team - they go and get sponsorship from companies (Lalita, February 25, 2009).

Yet, professional development specifically targeting the OLPC laptop program was clearly lacking at Yuva. A reason for this was the fact that there was very little internal knowledge about the laptops and no supporting literature given to teachers along with the laptops. Hence, teachers needed to spend the time searching through the OLPC wiki to self-learn how to use the laptop and develop their instructional styles to accommodate the laptops. In general, a wiki is a highly dynamic form of media that teachers might find daunting to peruse for further orientation to the OLPC laptops. Hence, this represents a less than ideal situation.

Due to the class teacher's lack of time, the role of designing activities would typically fall to the computer teacher but since Munira was also busy catering to computer activities for all classes, the onus for identifying or designing classroom activities fell on Veena. Veena was a Yuva volunteer but proved valuable since she was a software engineer and familiar with the OLPC laptops. This however created an external dependency for knowledge and support, although Veena's regularity and commitment to Yuva was commented upon on more than one occasion. In fact, Veena was so associated with the laptop program at Yuva, that she was taken to be like another teacher at the school. The degree of trust she received from Yuva was high, and she usually borrowed the OLPC laptops to design activities with no questions asked. It seemed that the expectations that she would be in at certain times each week to administer the program were ubiquitous among the other teachers, the principal, and the CEO who all held her voluntary efforts in high regard. Thus, although external to the school, by her involvement in the program, Veena was taken to be an insider to the program.

Veena along with the other internal stakeholders in the program did face challenges with other external parties associated with the OLPC program. Most notably, these challenges were to do with procuring technical support (eg. repair and replacements) for the laptops when components stopped working as they should. Multiple stakeholders associated with the laptop program at Yuva were frustrated and felt helpless about the fact that they needed to depend on the Foundation that distributed the laptops

when things went wrong with the laptops. Stakeholders pointed out that initially, communication lines were strong, but in recent months, the timeliness and nature of support they received was lacking in many ways. When I explicitly asked what the formal role of the OLPC and Foundation was in this implementation, none of the stakeholders including the CEO, principal, and teachers associated with the program were able to clarify this. This could presumably be because the terms and conditions of distribution were not clearly stated and laid out by both parties at the time the laptops were provided and accepted. Further, while the names of two specific people were repeatedly mentioned in connection with the Foundation that coordinated the distribution of the laptops, the school did not seem to have a formal tie up with the Foundation. Teachers and the principal did not know whom else they could turn to for technical issues since the OLPC laptops were not only new to Yuva, but new to the Indian context as well. Formal support mechanisms or even informal ones are not currently available and experts would be difficult to come by locally. The principal, Priya, was even considering contacting past students at MIT to try to arrange some kind of direct connection with the OLPC for support.

> Right now, there is another school in Bangalore where the OLPC laptops are being used for sixth standard. I spoke to Mr. John, who has been working there [a visiting volunteer]. He has connections at MIT. I have two of my students at MIT, so I want to see if I can set up something that will help us on the technical front. I will have to check on that (Priya, February 25, 2009).

> We have tried to coordinate with the Foundation that first gave us the laptops to provide both support for the laptop as well as laptops for more children (Sarika, February 24, 2009).

> Sometimes, after 4 hours [of charging], it shows green light - but it doesn't work. All technical problems. We wrote to the support group and called them a few times but we have not heard from them till now. We have to try to contact them again.

> A big challenge for us is the lack of continuous technical support. I wish we had support on a continuous basis. For instance, six of the laptops are not working now. And there is always a flaw. A technical flaw always happens. It has to be ongoing [the support] (Priya, February 25, 2009).

> [Ron] is just our administrator and he is admin, all that side. He does not involve in education department. He is just to handle all the problems we have with the computer. He trains us once a month about anything on the computer or virtual classroom. He doesn't know anything about the laptops. Till now, if I have problems, I will call or email Anand [from the Information Age Foundation]. But it is not easy. He tells me he will send one person, one local person. Still they have not come. Also past 4-5 months, 1 laptop is 'on its way' [laughs] (Munira, March 05, 2009).

Both Veena and Munira also raised the issue of access to software and upgrades, which was currently lacking with the Yuva implementation. Even knowing about new activities for the laptop, there would be no way for those features to be procured and used without teachers having some channels for evaluating, trying, and learning the features.

> If one laptop is connected to the Internet, all 24 will get connected. That is very advanced. I have never seen that. But we are not using that. For that you have to get the special software — we don't have that (Munira, March 05, 2009).

> Next year I will find activities some from the wiki download. But if someone downloads and sets up software, upgrades, and activities for us it will be ideal (Veena, February 20, 2009).

Veena and Munira expressed that having a support group of other implementers (even if online) would be a good learning resource that they could use as a forum to share ideas and reach out to others in case of issues.

> I feel it would be nice if I have a problem I can use a forum or discussion or chat where I can get ideas. Also human beings have different ideas, we can share with each other — I can learn from them and they can learn from me (Munira, March 05, 2009).

Apart from technical support for issues, Veena also pointed out the need for ongoing support for operating system upgrades and installing new activities. Even though the OLPC wiki is a good resource for downloading the latest activities at any time, teachers seemed to seek a more structured form of support and someone tangible they could contact to discuss operational challenges.

> I take care of the activities to be downloaded from the wiki or installed. Thanks to meeting Mr. John [the visiting volunteer at the other school where the laptop program is being implemented], he gave the next

> software update (for the next version of Sugar, the operating system) and how to go about it. He installed the update in minutes, you know (Veena, February 20, 2009).

Research Question 2: What expectations do stakeholders have of the OLPC laptops and what does this tell us about their technological values and identities?

The second research question asked what expectations stakeholders had of the OLPC laptop and how these related with their technological identities. The term "technological identities" is used to refer to the values around technology that have been constructed and expressed by participants in negotiating their own personal identities as their daily practices are increasingly technologically equipped (eg. see Lankshear, 2003). Traditionally, literature exploring the use of computers in classrooms often portrays a two-sided value-difference between schools' management (who represent the policymakers at the top of the hierarchy) and teachers (who represent the ground-level implementers) [eg. Cuban, 1986; Cuban, 2001; Egbert, Paulus, & Nakamichi, 2002; Nordkvelle & Olson, 2005]. This tends to paint the picture of an inherent top-down system orientation with little agency attributed to people at lower levels of the hierarchy, or alternatively one of an implicit tug-of-war where teachers tacitly comply with high-level policymaking but only to the most basic level required. In addition to policy-level value disconnects, the success (or lack thereof) of adopting technology in the classroom is also sometimes attributed at the individual level such as with Rogers' (1995) diffusion of innovations theory, which argues that individuals have different degrees of openness to technological change. Rogers' well-known innovation adoption curve depicts individuals on a spectrum of openness, ranging from innovators on one end to laggards on the other, with early adopters, the early majority, and the late majority falling between these two ends. Of course, Rogers' model applies to product adoption rather than education but in the field of education, there have been adaptations of this idea adopting similar labels to categorize the degree of receptiveness and comfort level of teachers to classroom technologies (eg. Cuban, 2001; Schuldman, 2004; Wilson & Stacey, 2004).

Such findings led me to wonder if I would find one or more of these scenarios in the context of this study (i.e., top-down push for technology use but implementer-level

resistance, implicit tug-of-war between management and implementers, or "typifiable" individual attitudes to technological adoption). However, in purposefully exploring the technology expectations of the various stakeholders associated with the laptop program, I found that there was actually *not* a clear-cut duality in technological values and expectations between the management who shape policies around laptop use and teachers who implement the program on a day-to-day basis. There were in fact, *both* overlaps and differences in technological values among the various stakeholders associated with the laptop program at Yuva. In terms of overlaps in expectations, participants expressed shared hopes about the current implementation and shared concerns about the future of the laptop program at the school. The shared values around technology within the school system could be due to the way Yuva is structured, where there are multiple stakeholders at various levels associated with the laptop program. Possibly, it could also be due to the outside-in nature of the OLPC program, which could imply that we might see more value differences between external program stakeholders (eg. the makers and distributors) and the stakeholders within the school who are simply trying to work with the laptops as best as they know how. As well, while individual attitudes around technology adoption and integration varied, they were not classifiable into a rigid categorization scheme where one individual could be clearly attributed as one "type" and others as another "type" (eg. participant X is an early adopter, while Y is a laggard). Such a model of schematizing and labelling individuals is also not of value in terms of the theoretical perspective of this study, which aims to explore the multiple perspectives of individuals rather than reduce them to simplistic archetypes.

Where there were different expectations around technology in general or the laptops specifically, they were based on participants' personal histories, different experiences with technology, beliefs about child development, and their philosophy of education. This seems to indicate that technology values cannot be viewed as unitary or monolithic entities associated with one particular group and distinguishable by where in the implementation hierarchy this group is located. Rather, we must also understand how factors outside of the school system such as personal educational histories, identity development, and technology exposure shape these values (and are in turn reshaped during the process of implementation within the system). The rest of this section

discusses the various shared and individual technology values that were seen to translate into how the laptops were ultimately used at Yuva.

Exposure to the laptops for below-poverty-line children was seen as value in its own right

The most striking similarity in technology expectations seen among multiple stakeholders in Yuva's laptop program was common values around providing laptops to below-poverty-line children. The majority saw access to the laptops as value in its own right. They seemed to echo the unanimous view that when socially disadvantaged children were exposed to technology, technology could be an emancipating force. The rationale provided was that for slum children with no prior exposure to conventional forms of day-to-day technology (including cell phones, automobiles, televisions, and computers), the access to a piece of technology all for their use was akin to a "miracle" since it now gave them opportunities that were previously only available to other children from higher socioeconomic brackets.

> When people asked me what was the vision for Yuva, I showed them a picture of a girl sitting down in front of a thatch hut in a slum, reading a National Geographic magazine. To me that is a very powerful image — one that is very *symbolic* too. However, it is not about transplanting them from where they are. Giving them opportunities does not mean transplanting them to a residential school… Make what is modern, contemporary, available and accessible to them (Sarika, February 25, 2009).

Teachers at Yuva often used words such as "miracle", "magic", and "privilege" to express why they thought access to the laptops was so symbolic for children from below-poverty-line families. The computer teacher and class teacher in particular, focused on the import of the laptop in the lives of children from such backgrounds.

> As they come in from the slum areas, they haven't seen such things that they are seeing here. It is something new and special to them. Laptop, they have just not thought of at all. So it is like a *magic* or *miracle* [italics added] to them that they have it now (Munira, March 05, 2009).

> Using laptops in the early age is a really dignified one — it is a *privilege* [italics added] (Lalita, February 25, 2009).

According to the teachers, the laptop represented the chance for children to have new experiences that would not have otherwise been afforded to them by virtue of their socioeconomic backgrounds. Children's initial reactions to receiving the laptops reportedly ranged from disbelief and incredulity to excitement. Further, since the arrival of the laptops, teachers claim that motivation for laptop use has been consistently high, with no signs of waning interest.

> Oh, they were very happy [when the OLPC laptops first came in]. They have not seen anything like it before. They are very lucky too. You tell me which other kids even in middle and upper class families have such facility (Lalita, February 25, 2009).

> Venus, it was like when they got the laptop, they were like, 'Oh it is for us, it's not for you!' They felt they are special so they got it (Munira, March 05, 2009).

> When they were told that they were getting laptops, I saw the change in my class. 'Akka is going to give laptops for Venus'. One thing was surprising, again and again they would ask, 'Akka you are really giving?' They thought it was me giving it! It was I who first gave it to them and they reacted with so much excitement. 'Thank you akka, I love you akka, you are very nice akka!' (Munira, March 05, 2009)

> We have not seen any loss of interest ever since the laptops came (Munira, March 05, 2009).

The CEO's views of the laptop were based on its potential for children and its synergy with the school's technological identity

Sarika, the CEO and Founder, viewed technology as a "strategic fit" within her philosophical goal of setting up Yuva and her administrative goal of education as a precursor for development.

> When I was a student in college and university, I studied business management. Back then I volunteered with Mother Teresa for six to seven years, and met her and worked closely with her. Somewhere that left an indelible impact on me. Of course, the family expectation at the time was for me to get into the corporate world. In 2000, I decided that enough is enough. After 26 years, I knew that there is much more to life. By then my daughter had finished studying at a US university and was independent. My husband also, who has been in the corporate world was thinking along similar lines, and even about quitting corporate life. I was given the

> opportunity to start an NGO in India. I learnt that there are enough resources in India to do this — we don't have to keep running to the West. My focus was on professionalization, but at the same time, you can't play God in such things. You are just a facilitator. I remember there was some foreign groups working with us at the time and they had some good ideas but they wanted to do things their own way and give the children peanut butter sandwiches for breakfast. I mean what is that? Nobody here eats peanut butter sandwiches! Idli and vada and sambar is just fine, it is a staple. So, you are then creating a different dynamic that the community is not prepared for. For me, it was like, I know my people, you know. It is more than a flag in the map. So that's how the whole thing started. I started working from home at my kitchen table. I am most productive in the kitchen and I didn't have a space yet, so I used my kitchen to think things through. I have to say one thing that really helped was the people I knew and had met during my years at work. These people believed in me, and in my ideas. As for money, I checked my bank balance. We had done well, my husband and I. We are not big spenders, hadn't really put too much into stocks and we're not from a business family. So we thought what is all this money for? So I started with my life savings. At the time, I never realized it was going to be so big. Of course, the people around me said, `Sarika, you don't ever do anything small'. I need elbow room, lots of things together. Think big. That's where technology comes in — the *strategic fit* [italics added]. It is generally believed that slum or street children should simply be given basic needs such as vocational training or food and supplies. I am not against vocational training but I am against one way for the rich and another for the poor. The inequality bothered me. To me, technology is one way to meet the gap. I'm not very tech savvy or anything, but my point was that I was passionate about these kids getting as much or more than other kids (Sarika, February 25, 2009).

Sarika's strategic-fit perspective explained why Yuva accepted the laptop program in the first place. Contrary to my expectation that the OLPC laptops would be the first technology exposure for students at Yuva, I discovered that Yuva schools are already well-equipped technologically (better so than many other private schools in urban India that cater to India's middle and higher income brackets). For instance, each Yuva campus was equipped with a virtual classroom with videoconferencing capability and interactive whiteboard technology long before the OLPC laptops arrived at the schools.

Interactive whiteboards[10] are a premium in schools in developing countries due to their high costs, but their presence at Yuva indicated that the school consciously kept in touch with advances in educational technology and perceived value in introducing and using these technologies. While corporate sponsorship by technology companies explained *how* these technologies have been accessible to the school, the management's view of technology as a strategic fit explained *why* they had been sought and implemented in the first place. Rather than simply accept what was given, the management at Yuva seemed to weigh the pros and cons of using particular technologies in terms of the daily functioning of the school, the target audience, and the potential for use within the curriculum.

> In fact, the OLPC laptop is quite new to us. Long before the laptop, we were running the school. We didn't seek out the laptop. The laptop was given to us as a donation. We didn't go after it. They found us and shortlisted us to give us the laptop thinking it would be a good environment for the laptop to be used. We have the Virtual Classroom with video linking facility that connects all our four campuses. We hold many sessions, including training, workshops, meetings, and classes in the virtual classroom. My concern is that it is not yet being used to its full potential. So anyway, the virtual lab came first. The laptops came later as a bonus. They walked through our door and said, 'would you be interested?' First thing I asked was, 'are they tamper proof, can they be carried home?' And only then did we accept them.

Sarika's view of technology as a strategic fit was tempered by the recognition that simply providing technology for the sake of giving it would achieve little. Her focus was to make the newest opportunities available to children but in a manner where technology was viewed as the fit within a larger system where issues like professional development and teacher mindsets were also addressed.

> This digital divide and all is much of a cliché [gestures disdainfully]. We went through a phase here in India where computers were being dumped into schools just to be technologically equipped. But that is no use if you

[10] An interactive whiteboard is an interactive display that combines the ability to screen projected images from a computer and interact with the display using the whiteboard screen. Interactive whiteboards typically use touch- or pen-based input systems to allow user input directly from the screen. The SMART Board (http://www2.smarttech.com/st/en-US/Products/SMART+Boards/Front+projection/) is one of the better-known commercially available interactive whiteboards.

> don't change the mindset and the teachers. Technology is part of a system, an environment (Sarika, February 24, 2009).
>
> [The ABC Computer Company] donated a whole lot of computers to government schools and they are not being used — they didn't even know *how* to use it. It's not just material we are providing. If you are going to do it, do it the whole hog ways (Sarika, February 24, 2009).

In this sense, Sarika viewed the capability and viability of technologies as being inherently tied to changes in systemic practice (similar to Kozma, 2007). She did not see technology as value neutral, but at the same time, she did not see it as being an automatic agent of change. Setting up the right environment for learning was of primary importance to Sarika, and if technology was used as one way to achieve the building or enhancement of this environment, then she saw value in its use.

> I think that creating tools to upgrade learning and make it fun, and of course making it similar to education in other schools, is important. But it's not the end in itself. We think that the laptops will change everything. But you should look at the system — the content, the subjects, the curriculum, the teachers. I have a similar example. Some people thought that introducing the midday meals scheme alone will increase attendance in government schools. Yes, it did to an extent, but kids should not be coming to school only for the meal but because they are engaged in the learning and finding it fun. In our school, there is a less than 1% dropout rate and 97% attendance. They enjoy being in school. They are not beaten. They are cared for. And children love to learn — you create the right environment and they will themselves create the wonder of discovering — it is such fun for them.
>
> The laptop is not only a laptop, a piece of technology. It is a resource that can help the children learn about the world outside. We need them to explore it in different ways (Sarika, February 25, 2009).
>
> Just giving a laptop is like planting a rose plant in a desert. Without the right resources, it will not be used or useful. We need to instead look at the environment. Look at the things to be repaired or looked at. In India, there is the tendency to only look at the shortcomings of education in terms of the hardware or materials (for example, classrooms, blackboards, toilets, meals) and not as the *content* (Sarika, February 25, 2009).

Like the other stakeholders in the laptop program, Sarika believed that the use of the laptop should be integrated with the curriculum rather than function as a standalone

program. She pointed out that Yuva had consciously structured their existing computer classes and programs in an integrated manner with the syllabus and would like to see the use of the laptops reflect this curricular integration focus as well. However, within this curricular use, she viewed technology as a way for children to explore, gain exposure to the outside world, and enjoy themselves. This was representative of her larger philosophy of education itself, which seemed to value experiences and interactions outside of subject-based learning as crucial to children's development.

> You must have noticed the large group of visitors that were here on the day you arrived. I love interacting with visitors. A visit, a discussion with outsiders is education in itself. That is what I am talking about. That education is bigger than your lessons and subjects. My children have to live in a world where people are so connected (Sarika, February 24, 2009).

> All our children learn computers from grade 1. It is not computers as a subject but something to just let go and have fun. It is integrated with the lessons and subject plans (Sarika, February 24, 2009).

Interestingly, while Sarika's expectations around laptop use were largely optimistic and at the level of their potential, they were not neglectful of the practical, systemic considerations that could shape how technology ultimately translates into practice. She also stressed the need for attention to teacher development and even parent orientation, indicating again that she realized the interdependent relationship between technology and the system within with it is implemented. Sarika's optimistic views about the potential of computers in children's education echoed her can-do attitude about enabling change in people's lives through education and development. She was not as positive about the government's methods to achieve this change, and instead, expressed a preference for private efforts to work towards country-level development goals. Her faith in the private sector could be due to her twenty-five years of experience in the corporate sector in various management roles. The efficiency and timeline focus of private organizations seemed to have contributed to shaping her views on setting and achieving goals. Simultaneously, her years volunteering with Mother Teresa seemed to have made her highly aware of the dire conditions that many youngsters dwelled in and the criticality of bringing change to their lives.

> Private organizations, I believe, should set up private initiatives. If you try a government partnership, you will have a 60-year project and you need lots of money to burn. For us, the need is more pressing. For every child on the street, it is critical. There is a burning need to be encouraged. We got 996 kids off the street. Do you know that at least 96% of the kids have one or more family members in jail? It is an everyday reality — they are exposed to violence. It is a natural progression for them to take that route too but our kids are removed from all that… Many of my kids may become bus drivers. Ambitions are not always reality. But those bus drivers will send their kids to school, not beat their wives, follow traffic rules, and that itself is a big change (Sarika, February 24, 2009).

It was also evident that while Sarika held day-to-day academic administration important, along with her management team, she had many foundational management-related responsibilities in ensuring the smooth operation of the Yuva schools including fundraising, program planning, record keeping, accountability to sponsors and families, selecting children, scaling existing operations, and benchmarking against other schools and development programs. At the top of her priorities was the fundamental need to secure funds to ensure continued operations on a month-to-month basis.

> First, so many children aged 4 to 14 in Bangalore don't go to school — so how do you select children, and how do you scale? Next, there is competition in terms of the numbers game that many other NGOs play. For instance they will provide 6 lakh meals to children or provide 50,000 children access to libraries. People always compare the large numbers to our 996. They don't realize that it is challenging and expensive to provide quality education. Then there is the fact that we are a private initiative while other NGOs work within the government system. [XYZ] Foundation goes into government schools and tries to create change. This model has its relevance but those are huge numbers, and it requires grit to manage those numbers or quantities without compromising on the quality of services and facilities provided to children. We are about quality, but about more than quality — we are about equal education (Sarika, February 24, 2009).

> I have just come from a frustrating meeting where we were trying to explain what Yuva is trying to accomplish. I keep having to make this clear to people — we are not a charitable organization, we are a development organization. And yes, things do get difficult because of this because people want to contribute to charitable organizations who do not have much to begin with. They say, 'at least you have the basic resources and your operations are up and running'. So sometimes I wonder how we are going to pull on to the next month and how I will pay salaries three

> months from now. But am I not going to paint my walls because there is no money? No way! My kids come from such depressed backgrounds that school is a place of hope. So we will *somehow* manage funds to pay salaries. We are not too well endowed to receive grants. But we will not accept charity. We are teaching our children dignity, right? We have to be dignified even in our poverty (Sarika, February 24, 2009).

> In government schools I could go on and on about the infrastructure. Here, we too have our limitations but our schools are colourful and filled with happiness. This school has challenges too. For example, we need to do painting for the entire school. People who walk in mistakenly think we are well funded but very few people know that I have gone through *huge* amounts of anxiety (Sarika, February 24, 2009).

The principal's expectations around the laptop were based on foundational doubts about the ability of technology to motivate students

Unlike Sarika, whose views of technology were largely optimistic, Priya (the school principal) expressed doubts about whether technology could motivate learners. She viewed the laptops purely as a tool supporting a learning process based on personal interactions, and not as one that could inspire learners to take control of their learning processes.

> Laptops are not the priority as far as I am concerned. It is only a tool. I have my doubts how useful the technology will be. Motivation does not come from machines. It comes from people they [children] interact with. Technology is only a means, a conveyance. If it is treated as the end, then it will be misused or not used as intended (Priya, February 25, 2009).

I tried to understand what underlying assumptions could be shaping Priya's views about technology. In the course of observations and interviews, I found that Priya had spent several years in holistic-education focused schools.

> I taught in a school in Delhi, which thought of education not just as academics but more broadly. I then worked at Loyola Jamshedpur which was a different experience but still alternative. They focused on spiritually coordinated education. That was a very different experience. Then I went to Pune where I worked for a Krishnamurti Foundation School. So basically all these were about education at a holistic level not just the core academics. Then I spent 6 months in an international school after moving to Bangalore. I found it disgusting and quit. It was too commercial. That was when I applied to Yuva and I am very happy with that decision (Priya, February 25, 2009).

Alternative-focus schools in India are a radical departure from the content-focused curricula of the central and state boards. They question the value of content-focused systems at a philosophical level and their pedagogical practices represent a conscious departure from a coverage-orientation to an experience-orientation. The focus is often on more holistic pursuits such as learning to become an all-rounded human being. Having spent many years in such schools, it seemed that Priya's educational perspective tended towards the philosophical, focused on the pursuit of holistic dimensions of education such as values and character building in addition to the overall curriculum. She saw people as being key to bringing about change, including her own role as the principal where she adopted a considerably hands-on approach in interacting with children daily (even on a minute-to-minute basis).

> I have always been in schools where hands-on is a way of teaching. So that is the only way I know and want to be (Priya, February 25, 2009). [As she finishes this sentence, and almost to confirm it, two children run in to show her a writing assignment they were given, others drop by to say goodbye at the end of the school day, and one boy comes in to give her an update on his accident crossing the road the previous day. Every time children come in during the interview, Priya excuses herself from the interview to attend to their needs and questions].

> You know, one thing is that even though CDS [Community Development Services] is in constant touch with the children and families, I want to be a part of every child's growth and development (Priya, February 25, 2009).

This strong people-focus explained Priya's take on technology as being only a *conveyance* or a *means* and not the focal point of the educational experience. She did not necessarily see technology as harmful or helpful, but rather, took a questioning stance regarding its potential to add value to existing instructional practices.

Another aspect of Priya's daily administrative role that could have shaped her value perception of the use of the laptops by students was her situated knowledge of the sociocultural background and experiences of the children at Yuva. Priya was well versed in the children's backgrounds by way of training and visits to the children's homes, but also in terms of her daily interactions with children as a primary "go to" person for issues of an academic and personal nature. Priya frequently and actively involved herself in

addressing issues that children faced both at school and at home. The children who attended Yuva most often relied on the school to solve their day-to-day problems such as medical issues since both parents were often working (if they had one or more parents) and additionally, could not afford medical care within their basic means. In Priya's mindset, these daily human concerns seemed more pressing to address than other seemingly trivial ones like the introduction of new technologies that come and go.

> The thing is that each day comes up with a new problem — something I haven't seen before. For example, one day I came to school at 7:45 AM — I am usually here before anybody else — and a boy came and said, 'good morning mummy', and next thing I saw he has a broken hand, his hand hanging from his elbow. I didn't have time to think. I immediately locked the office and rushed him next door to the hospital and had to have it fixed. Then there was another time when a mother immolated herself. The child did not come to school and the neighbouring child came in. She had hardly said 'good morning mummy' when she told me the news that this girl's mother had immolated herself. I dropped everything and went to visit the girl and her family (Priya, February 25, 2009).

Unanimously referred to as "mummy" by all the school children (even though all other older female teachers and volunteers are called "akka"), Priya seemed to hold a special place in the children's regard, and it was not uncommon to see children drop by her office just to greet her or even to seek her opinion or approval on something specific. The combination of her hands-on approach and children's clear affection for her made her daily role quite unique as a school principal, in terms of her "nearness" to the daily academic practices. She got involved in high-level yearly curricular planning for all classes and yet also had end-of-day meetings with teachers to discuss daily progress and issues. Her role also involved acting as a liaison between the management and implementation divisions of the school although this was not a strict division.

> I am the point of interface between the management and the teachers but even so, the school encourages an open door policy. I am very much involved in matters of curriculum planning and also the Long Range planning for each class, especially for maths. My subjects are maths and physics, so I tend to be very involved when it involves those subjects. And of course, English, since that is a core focus of the teaching here (Priya, February 25, 2009).

Clearly, for Priya, the prime responsibility was to ensure the smooth running of the daily operations of the academic wing at this Yuva school. She did this by working closely with the various stakeholders as an insider rather than an outsider. Priya took a holistic approach to addressing roadblocks that might impede attendance, motivation, and learning by involving herself actively in children's lives and ongoing development, teachers' practices and frustrations, and even the families and communities that sent their children to Yuva.

The class and subject teachers' expectations around laptop use were based on how they supported subject teaching and their students' individual needs

Both the class teacher of the Venus class (Lalita) and the EVS teacher (Runa) expressed expectations around the laptop based on two key factors: its value in supporting learning in their respective subject areas and its appropriateness for children from low socioeconomic backgrounds. Runa saw the potential of the laptop as a learning tool to support independent, creative thinking and learning. She thought children were naturally imaginative thinkers and only needed a little facilitation to develop their own thinking processes.

> First time I was curious — I explored to try it (the laptop). It has potential for EVS but we don't have block periods for EVS. If used, the benefits are that the children love to learn, love to type, draw pictures, create… creativity instead of spoon-feeding. I want them to think and learn by themselves. I should be a facilitator. That's how the thinking processes develop until the age of 7. From birth till now, that's how the brain cells develop. Once, I asked them to do solids, liquids, gases — things that dissolve in water and not. They came with simple examples like Surf Excel, Boost, Nescafe — very simple concepts. That's how they think and surprise me. And they come up with lots of questions. Think and practically experience. They won't forget it because they found it out themselves. They even copied the spellings down from the packages. Children can surprise you (Runa, March 04, 2009).

The way the laptop program was structured around block periods meant that Runa did not get to use the laptops in her EVS classes. Perhaps for this reason, Runa's values around the use of the laptops seemed to be at a higher level (i.e., detached from the problems of day-to-day running), embodying enthusiasm for the laptops' potential. Her description of the potential of the laptop to support learning seemed to be rooted in her

own instructional philosophy and practices. In observations of her classes, I found that she tended to adopt student-centered collaborative activities as a way to get students to collaboratively develop their knowledge. For instance, during one classroom session, where the subject theme was "How to keep your classroom clean", rather than lecture about the topic or get students to read the textbook, she broke the class out into four groups and asked each group to think about and come to a collective understanding of what they thought keeping their classroom clean entailed, and then enact it for the rest of the class. Each of the four groups was assigned one interpretive form for the enactment, including a skit, poem, dance, and song. During the activity, the children were constantly enthusiastic and engaged within their individual groups. After each group enacted their interpretation of keeping the classroom clean, Runa wrapped up the session by summarizing each group's ideas and highlighting the value of these different interpretations. Other class sessions that Runa took were similar in nature, indicating that she was not concerned with students developing a right-and-wrong understanding of her subject, but rather, wanted children to tap into their individual and collective creativity and express it in an open environment of learning. Her views around laptop use were clearly based on this optimism in the creative capabilities of children.

Like Runa, Lalita also saw the laptop as a means to enhance student motivation as well as their thinking capacity, based on her firsthand observations as a key stakeholder in the laptop program. She found that children were particularly engaged in the classroom during laptop sessions and even competed for attention and credit from teachers.

> You have seen the kids. When they have done one, they very soon want to go for the other. So they are sharp (Lalita, March 12, 2009).
>
> With the laptops they are busy with laptops. They don't interact with anyone. They are very engaged with the laptop — they will ignore everyone (Lalita, March 12, 2009).
>
> Almost all the children can independently open the activities. Almost all have learnt. Because there is a competition, first each one wants to grab and do (March 12, 2009).
>
> Some children don't feel like writing, but laptop is like a play thing for them so they feel interested and motivated. It increases ability and

> creativity. Thinking capacity also increases because you see the speed of typing and all (Lalita, March 03, 2009).

In contrast with Runa however, Lalita formed expectations around the laptop at a more implementation-oriented level. The big departure from Runa's expectations was that Lalita's was experientially driven as opposed to Runa's potential-orientation since Lalita had been involved in implementing the program for six months already. Naturally, this made Lalita more aware of the capabilities and challenges of minute-to-minute execution. It might also explain why her views of laptop use were not purely optimism-based unlike Runa's views. For instance, while Lalita claimed that the use of the laptops was a source of inspiration to less motivated learners in her class, she also contrastingly pointed out that it could be a source of distraction as well. She pointed out that specific learners in her classroom were often distracted due to their lack of familiarity with using the laptop and would start to distract other children working on their laptops as a result.

> The children who knows will use it smoothly. When they know to write and read, they will do it quietly and quickly. The children who don't know, they will distract others. Same as without laptop (Lalita, March 12, 2009).

Lalita found this to be true of non laptop sessions as well, which indicates that she believed that student ability could have a bearing on students' engagement and learning with the laptop. She took a one-dimensional view of student ability as a split between what she called *weak* and *strong* students, based on the results of continuous performance assessment and her observations of their level of engagement in the classroom. In fact, Lalita claimed that about 50% of her class comprised slow learners.

> You might have observed that slow learners are not doing. Because others are doing they will try. But they are not really interested. [How many of these students are slow learners?] To be honest, about 50% (Lalita, February 25, 2009).

This made me wonder how she perceived the sociocultural and economic background of the children would shape learning with the laptops. Lalita confessed that she was not fully clear on how feasible the laptops were for children of this age group and socioeconomic background. She focused on the background of the Yuva children,

pointing out that the laptop represented a resource far removed from the realm of their daily lives, a unicorn so to speak, until Yuva made the laptops available to them.

> (Shrugs) I don't know. Somehow, in normal schools only I have not seen. I want to know what extent it will help children like these. I think we give more than they need. When they cant even afford a notebook also, this laptop is like a dream for them (Lalita, March 12, 2009).

However, both Lalita and Runa were optimistic that the children at Yuva would learn to work with the laptop just like any other children would.

> Once they are exposed, they will learn - they are like any other children. With the right exposure to technology they will pick up too (Runa, March 04, 2009).

> [The children's background has] no effect. Any kids will use that way (Lalita, March 12, 2009).

Thus, it seemed that teachers at Yuva had confidence in their students' capabilities despite manifest issues such as children's psychological and learning differences and their below-poverty backgrounds. But at the same time, they currently did not have the knowledge or confidence about the OLPC laptop that would help them to make assertions about its role in their students' learning process.

Another factor shaping teachers' technology values included their experiences with the laptop's ongoing use. As pointed out earlier, Runa was not involved in the day-to-day implementation of the laptop program and therefore had considerably less to say about the use of laptops than Lalita did. A big part of Lalita's technology expectations around the laptop were shaped by day-to-day scheduling, planning, and class preparation constraints. Given that she already had to balance her teaching workload as a class teacher and subject teacher as well as other activities such as assignment correction, planning and preparation, class management, assessment reporting and professional development, Lalita found the inclusion of the laptops in her weekly schedule to be an added weekly responsibility that was not always easy to juggle. She pointed out that using the laptops with the Venus class added to her high teaching workload of 27 periods of teaching each week (of 40 minutes each), cutting into the time she would otherwise spend on lesson planning or corrections. Further, she highlighted that Venus class

teachers at the other three branches of Yuva did not have this added responsibility of the laptop program on a weekly basis.

> [My weekly workload is] 27 periods of teaching per week out of which 5 are social studies for Saturn [class], and the rest are English, Maths, Story, Art, and Life Skills classes for Venus. Art I am in right now because the teacher had to stop coming due to some work. Sometimes it is very much. Correcting the homework and managing the children at the same time is very difficult. Preparing for the classes also with the laptop I need some help for that otherwise there is just no time (Lalita, February 25, 2009).

> Only in this branch we have this OLPC program. It is not there in the other 3 branches. So the same Venus teachers there do not have to plan for the laptop activities. This is a lot of work (Lalita, February 25, 2009).

Lalita felt that the lack of time prevented her from being able to deeply get involved in learning to use the laptop to plan activities. Instead, she found it easier to give the OLPC volunteer an overview of the content and instructional goals for subsequent lessons and depend on her to download or design appropriate laptop activities.

> We work with the teacher to create the activities. Sometimes, we both (Veena and I) go to websites and use activities from there and give it (Munira, February 20, 2009).

> The teacher [Lalita] also knows what to ask for me. She is specific about what she wants for English and Maths. So it is easy (Veena, March 04, 2009).

During the actual laptop sessions (just like with any other activity-based session such as art or music), Lalita had to be in class since she was needed to manage the classroom and restore order. The fact that she was needed to handle classroom management even in classes taught by other teachers or volunteers meant that her available working time was further reduced.

> I prepare during free periods. But one problem is that in those periods like art and music, children are not coming into control so I have to sit in the class even that time. In these limited hours, I have to check the homework books (Lalita, February 25, 2009).

Lalita was also constrained by the fact that the laptops were used during block periods for her subjects, thereby cutting into time she would have otherwise spent

covering items on her Long Range plan for the year. Out of 11 of her weekly English periods, four were being used for laptop sessions and out of seven of her weekly Math periods, two were being used for laptop sessions. The laptops were intended to be used to support the curriculum and not supplant it. Hence, Lalita needed to ensure that she was not missing out on covering weekly topics within the plan for the year since these formed the basis for continuous assessment of students' progress during the academic year.

> Actually I am giving my regular periods (subjects) to practice on the laptops (Lalita, March 12, 2009).

> I give six [periods] to the laptop so I try to integrate the content with the laptop use so I will not miss the lessons or content (Lalita, February 25, 2009).

Even without the laptops, one big challenge for Lalita was the fact that many students came to school without completing their assigned homework. Parents' lack of education and literacy, and their inability to support their children's learning activities at home was cited to be a major factor contributing to non-completion of assigned work.

> These kids are all the same only, no? They go back to the same homes where the parents can't read or check their homework. The parents are not bothered and the children take advantage. They don't even do their homework or practice what they do in class. Naturally they will forget (Lalita, February 25, 2009).

Punishment was not permitted at Yuva in keeping with their educational motto, "Love, Explore, Excel", and homework defaulters were asked by teachers to complete their homework in school before joining in any activities for the day. However, for class teachers, the routine of constant defaulting became a classroom management challenge, since those students who were asked to step out to complete their unfinished homework missed out on the latest lessons and fell behind again. Lalita was frustrated with the number of children who did not complete their homework on a daily basis, and went so far as to say she saw more value in getting students to complete their homework than getting them to use the laptops on an unlimited basis (i.e. at home in addition to school).

> What I thought is that instead of taking the laptop home, let them do their homework properly and come. You might have observed that slow

> learners are not doing. Because others are doing they will try. But they are not really interested (Lalita, February 25, 2009).

Clearly, working within the constraints of these various logistical factors (eg. busy weekly subject-teaching loads and responsibility for day-to-day classroom issues and student performance) was not the most optimal environment to permit the class teacher to be creative with the laptops. In addition to these logistical factors, the nature of the student demographic at Yuva itself placed important responsibilities in the hands of teachers in terms of their daily teaching role. The role of teachers did not end in the classroom like in regular schools but extended to monitoring breakfast and lunch hours, when they accompanied the children to the eating area and supervised them to ensure they were finishing their food and eating enough. Teachers simultaneously ate their own breakfast and lunch, giving mealtimes a sense of being at a family table. I joined the teachers for lunch on most days, and once even tried the food given to the children, which the Yuva staff was welcome to eat as well. The food was always fresh, hot, and nutritious. On the day I tried it, the menu comprised steamed rice, vegetable sambar (a lentil and vegetable stew) and a cup of cool curd (yogurt). The menu was rotated for variety and children were allowed unlimited refills. In the evenings, children were given a protein malt and sometimes a snack as well, which class teachers distributed in their respective classes. Lalita handled this for the Venus class every day.

Further, just like the principal, teachers were faced with the task of handling issues that children faced during the school week. For instance, in the Venus class one morning, a child had been noticed by both Lalita and Runa to have developed some rashes on her palms and hands. Both Lalita and Runa called her personally and inspected her hands, legs, and back to check if the rash was spreading. They asked her if she had seen a doctor. She said that she had the previous day, and when the teachers asked her what the doctor had said, she said, “I play sand, akka”. This could imply that the doctor had diagnosed an infection from playing in the sand. When the teachers followed up with a second inspection on the following day, they noticed the rash was getting worse, and Lalita made a note to talk to the social worker about arranging another visit to the doctor. On other occasions, teachers had to handle hygiene and behavioural problems. Hygiene

in particular was a common issue. Sometimes, children came in with unclean uniforms or without basic grooming, so teachers had to help them tidy up in school.

> Look [Nagaraj], I had to clean this boy, comb his hair, clean his nose, and put a clean shirt and uniform. [I ask Lalita if this is common and she says yes, they have to groom the kids quite often]. The parents are just not bothered. They will send the children like that only. Dirty, no bath, dirty nose. We keep a comb and oil in class. They don't even know they should comb the hair! (Lalita, February 25, 2009)

> The kids, the background from where they are coming, we have to teach them from the basic. Other kids have their parents to help them — here we have to teach them everything — language, behavior, discipline, apart from their studies. This comes through parents and also from the environment, but they don't get it. They are not getting it at home (Munira, March 05, 2009).

Situations like these were unpredictable, requiring teachers to be spontaneous and go along with the flow as they arose. None of the teachers at Yuva expressed any resentment at having to take on this extra workload. On the contrary, they were more than happy to be of assistance to the children and the affection they felt for the children was always evident both to the children and a third-party onlooker such as myself. Even as they walked through the corridors, children would walk up to teachers with questions or even surround the teachers tugging at their *saris* and reaching up for hugs. The constant involvement of the teachers in some activity or situation through the day meant that teachers could potentially require time and support to get immersed in additional activities such as the laptop program. This could be why like in many other educational computing implementations, the use of the laptops "sustained rather than altered existing patterns of teaching practice" (Cuban, Kirkpatrick, & Peck, 2001, pp. 813).

The computer teacher's technology values were based on the inherent value of access to the laptops more than the details of implementation

The technology expectations of Munira, the computer teacher, most closely echoed those of Sarika, the CEO. I had expected her values around technology use to be similar to those of Lalita (the class teacher) since they not only shared involvement in the laptop program but also had similar daily practices in that they were both teachers

working with a similar target audience. I imagined this would give them a common grounding with regard to teaching practices that might influence their technology values, perhaps more so than their own backgrounds. Yet, the findings revealed that the two teachers formed technology expectations at very different levels. Unlike Lalita, who formed her technology expectations at the level of daily implementation details, Munira formed hers at the level of the transformational potential of the laptop. Like Sarika (the CEO), she saw technology as an enabler and as inherently value laden especially for children from below-poverty backgrounds. This finding is of particular importance considering that the values of teachers and school policymakers are often presented as being inherently divergent (eg. Cuban, 1986; Cuban, 1993). It could indicate that technology values are in fact not solely shaped by where in the implementation chain participants are located but also by a host of other factors including their backgrounds, attitudes, and comfort level with technology.

Munira was optimistic about the use of technology by children, and in particular about the OLPC laptops by children from a low socioeconomic background.

> Fantastic! What they [the OLPC designers] have thought about it and planned, they are doing a good job. They have done a unique thing which the kids are learning. Seeing the kids' background, I have no words. The laptop for them is like magic I think (Munira, March 05, 2009).

When I asked Munira what she knew about the philosophy the OLPC laptop was designed around, however, she was not sure just as with the other teachers. Despite the literature available on the Internet (on the OLPC wiki) and a brief teacher orientation to the OLPC laptops, there still seemed to be a gap in terms of how familiar teachers were with the vision and goals of the OLPC laptop. This could be problematic if teachers are being seen by schools as the primary implementers of such programs.

> I don't know *any*thing (laughs). They told [in the training] how it works and how it is to be used. They showed the technical part. The most funniest [sic] part was the 2 boxes on the side of the mouse. One teacher asked "even this is mouse or what?" They said, 'you can keep tea, coffee, and all.' And even if it spills on the laptop, nothing will happen. If the kids bang and treat the keys roughly, no damage will happen because the keyboard is made of rubber (Munira, March 05, 2009).

Apart from the fact that Munira saw access as value in its own right, she also saw tangible value in using the laptops for learning, based on firsthand observations of children's enhanced interest and concentration. She viewed the laptops themselves as having an intrinsic motivational value, regardless of specific activities performed on them, since children were fascinated with the idea of using the laptops as compared to regular classes where they used notebooks to take down notes. Thus, motivation seems to be an important aspect of providing laptops to primary children for learning purposes. Munira's teaching philosophy seemed to focus on tapping into the intrinsic motivation that children have to learn even without the laptop by guiding them to use their own imagination to explore and discover new things. She wholeheartedly agreed with the Yuva philosophy of teaching with love and kindness.

> With love, we [Yuva's teachers] make them understand. As my mother also, she has never lifted hand on my brother and me. Yes, we have to show some anger, but child can be taught in a good and soft way. For instance, my mother used to pick rice on a *thali*[11]. When my nephew wanted to play with the rice, instead of telling him to stay away from it, she asked him to draw alphabets in it, and he learnt the alphabets A to F and the numbers 1-10 in a single evening. My mother will say, you should not let the child think they are studying, you are enjoying, having fun. Here, the children are interested in computers (Munira, March 05, 2009).

Munira also pointed out that children seemed to be developing both cognitive and motor skills as well as subject-specific knowledge from using the laptops, due to their curiosity about how the laptops worked and what they could do with them.

> Yes I do [see a difference in the way children work with the laptop]. A slight change and a big change also. Normally they copy notes in the book — teachers complain about poor attention, bad handwriting and so on. But with the OLPC laptops have been given to them, full attention, full concentration, they just want to be attentive in the class. There are some differences but in each play what they want to do, for example, science or maths, that same concentration and presence is there. It's something that the laptop is being worked on — whatever we do, they will have fun. If you give it whole day also, they will not get bored. Yesterday you might have seen, when watching movie [in the virtual classroom], some were

[11] The word "thali" in Hindi, means "plate", and in this context, Munira is using the word to refer to the common practice in India of checking rice grains for impurities by placing them on a plate, sorting through them, and picking out the impurities.

> pointing to laptop and saying, 'akka, laptop'. So they never get tired of the laptop (Munira, March 05, 2009).
>
> First, their mind — how to work on, their hands, the curiosity of answering questions, to know how it works, what all activities they have to do. All positive way — knowledge about all the subjects — they are finding it easy and having the concentration. I guess they have gained a lot of knowledge in the OLPC (Munira, March 05, 2009).

Munira's positive expectations around technology led me to ask whether she had a technology background herself that prompted these views. By technology background, I refer to education in a technological field, exposure to computers from an early age, and overall positive experiences with computers. Surprisingly though, while Munira had taken some certificate courses in computers in India, her primary education was in languages (Hindi specifically) and commerce. She also did not own a computer during her childhood years. Taking the computer courses after her first undergraduate degree, however, helped give her the opportunity to apply for a computer teaching role at Yuva. She viewed teaching computers at Yuva as a vocation more than just a job, and this seemed to be due to both the opportunity she got to teach computers as well as to work with children from disadvantaged backgrounds.

> I am basically a second year B.Com student at Bangalore University currently. I am doing the course correspondence. I had done some computer courses in NIIT and I also did home science. My first BA is in Hindi at the Praja Samiti (Vidhwan). My teacher at Vidhwan was the one who helped me get to Yuva. She suggested I give a demo for a computer teacher position and I got it (Munira, February 20, 2009).
>
> I joined [Yuva] on December 1st, 2007… After I joined the OLPC came. I started off here teaching students at the computer lab — for Mercury, Sun, Venus classes (Munira, February 20, 2009).
>
> It is fantastic, undefinable [sic]! I have to say it like this — it is my life's first job — *zindagi kaa pehela kaam*[12]. Each day is a special day. It is not a job (Munira, February 20, 2009).

[12] *Zindagi kaa pehela kaam* is a Hindi expression that translates literally into "my life's first job" but figuratively into "my life's first *real* job". Munira uses the expression to depict her passion for her current job as the computer teacher at Yuva, and the fact that she sees it not just as a job but as something more meaningful — a vocation.

Munira confessed to being pleased with the freedom she had in implementing the laptop program at Yuva, but at the same time acknowledged that she was aware of the responsibilities that come along with the freedom.

> I have full creative freedom! All! You have given the in charge of looking after and taking charge. So it is your responsibility. You have to be good to the kids, their knowledge, because they are the ones who have to learn (Munira, March 05, 2009).

> I always see that I should not miss a class or any session with the laptop. If I'll be having other class, I should be there but Veena and the class teacher will be minding Venus class. I have only one period for this class so I can't also be here all the time. I can't neglect the others especially since they don't have the laptops, only the regular computers (Munira, March 05, 2009).

In summary, Munira formed her values around the laptop largely based on their potential for children from below-poverty-line backgrounds and to some extent on their potential as a learning tool. This was in contrast with the OLPC volunteer (Veena), whose expectations around laptop use were steeped in the day-to-day specifics of its running.

The OLPC volunteer's expectations around laptop use were based on daily operational constraints and capabilities

Veena, unlike Munira and Sarika, but similar to Lalita, formed her expectations around the laptop based on how day-to-day operational issues interacted with the broader goal of their being a learning tool. In the case of Lalita, the operational issues were at the level of subject planning, meeting the objectives in the Long Range plan, and assessment. For Veena, the operational issues revolved around situational and technology affordances[13] that either aided or hindered the smooth running of the OLPC program. She particularly stressed on the challenges of obtaining upgrades, activities, and software as well as getting all the laptops ready for each session.

[13] The term "affordances" is used to refer to the capabilities and limitations of a technology in terms of what it offers to its users. According to Gaver (1991, p. 79-80), "an affordance of an object, such as one for climbing, refers to the attributes of both the object and the actor. This makes the concept a powerful one for thinking about technologies because it focuses on the interaction between technologies and the people who will use them."

> To start with young children it is very good since we can start low and move up. Next year I will find activities some from the wiki download. But if someone downloads and sets up software, upgrades, and activities for us it will be ideal (Veena, February 20, 2009).

> One challenge you know, is the charging of the laptops. After every use, we should charge them but we can only charge five at a time because we have that many slots. It takes five hours to charge each one. So we have 24 working ones, we have to do it in five batches. The computer teacher has to remember to charge the others and rotate them, otherwise that's all. Especially on the weekend, if she forgets on Saturday, Monday no laptop can be used. Another challenge is that we have 29 laptops out of which 25 are not working. So the kids have to share the laptops. That's why we use partners in the classroom activities (Veena, February 20, 2009).

> One difficulty I have is this system upgrades but I told you no, that [Mr. John] gave it to me on a pen drive. In the future, they want to bring this on a pen drive and it can be run on any machine. It is not heavy — it is a zip file — it is small and does not take time to upgrade (Veena, March 04, 2009).

Sometimes, the technological affordances of the laptops themselves were aspects Veena had to consider in planning for and implementing laptop activities. At other times, her lack of familiarity with the interface was a factor she found constraining in terms of planning which activities to use and how. She pointed out that this was also the case for teachers even for months after the laptops first arrived at Yuva, due to their newness in this context. Her comment raised the deeper issue of the lack of a knowledge base or community of practice that teachers could turn to when planning such implementations.

> Sometimes, the pen drive behaves crazy in this laptops, I don't know why. With this memory, the CD drive is difficult. I load files before only if possible, otherwise, I will do the same day (Veena, March 04, 2009).

> This [not knowing how to use some activities on the OLPC laptop] is one big challenge I am facing. I have not even touched many of the other applications because I don't know how to use and where to start. Plus, some are for older children (Veena, February 20, 2009).

> I joined only in August 2008. The laptops came long ago — 6-7 months ago in the beginning of 2008. No one knew how to manage it. From September, [the team from ABC Foundation] came and conducted a session. The teachers got more confident. I was not there but the teachers

> were only then able to see how the laptops could be used in the class activities (Veena, February 20, 2009).

Veena's expectations around the laptop were not pessimistic, however, despite what her comments about the daily challenges might lead us to believe. For one, despite the lack of lead time she had to plan and design activities for subsequent sessions (as noticed during observations), taking the time to create or download activities at home was something she did not perceive as problematic. On the contrary, Veena seemed to enjoy this aspect of her role and was happy with the class teacher's inputs and cooperation that helped her create activities in tandem with the curriculum plan. Teacher support in planning activities seemed important to Veena, since she was not involved in daily and yearly subject planning but recognized that in order to integrate the laptop with lessons, the teacher's involvement was integral.

> Maximum one or half an hour I can finish [planning/designing] one lesson. Like yesterday evening, I worked between 9:30 and 10:30 and I finished nouns and verbs activity. I can do it easily. The teacher also knows what to ask for me. She is specific about what she wants for English and Maths. So it is easy (Veena, March 04, 2009).

In terms of expressing an overall view about the OLPC laptops for children, Veena expressed her concerns about the viability of the OLPC program in developing countries and resource-constrained environments. She was the only participant to question at a fundamental level the appropriateness of the OLPC vision of giving out laptops in developing country contexts, and express doubts about its feasibility. While Priya, the principal also took a questioning stance about the laptops, it was at the level of the ability of technology to motivate learners rather than at the broader level of questioning the idea of laptops for socially disadvantaged groups and contexts.

> It sounds nice but I don't know how they will do it successfully in India. They are doing it in schools like Yuva where infrastructure are not possible as compared to other private schools (Veena, February 20, 2009).

> It's not the question of the laptop. It is the vision of one laptop per child. Is that feasible in India? It will take a long time to succeed (Veena, February 20, 2009).

Veena's own questioning views about the OLPC are valuable to explore further in combination with other ground-level implementers' views to discern if there are patterns in what they perceive as the value of learning with low-costs laptops in these contexts.

Children's expectations around laptop use were based on access concerns, negotiations and transactions, and processes of discovery

The children's expectations around the OLPC laptop were grounded in the day-to-day details similar to Veena and Lalita, but unlike the teachers who focused on implementation details like how to keep things running smoothly, the children were observed to focus on micro-level interactions in the form of social and learning processes or transactions with the laptops. Their concerns revolved around making the most of the limited time they had access to the laptops, negotiating with each other for more "active use time" with the laptop (particularly when they were sharing), and discovering new features or ways of using existing ones and sharing their findings.

Most notably, children wanted more time to use the laptops each week. All seven children interviewed explicitly confirmed that they wanted to work with the laptop for more time each week. Overall observations also revealed that children asked for the laptop at random times during non-laptop sessions, with the hopes and anticipation of getting this much-sought treat. During a Thursday single-block computer period when the children were taken to the virtual room to watch a movie, they were distracted at various points by the presence of the laptops in the room and pointed to the laptops asking the teacher whether they could use the laptops then instead of watching the movie. This indicates that as Munira pointed out, there could be an intrinsic motivational value associated with the presence and use of the laptops from the children's perspectives. This could be both due to the natural curiosity of child learners but also due to the added element of their low-income backgrounds and lack of prior exposure to anything like a laptop. For instance, we might ask if children with access to computers at home and exposure to other technologies outside of school might feel the same sense of wonder and anticipation at getting to use the laptops that these children clearly demonstrated.

> [I want to use the laptop] more. Even more than now (Sheba, March 11, 2009).

> [I want to use the laptop] more. I like laptop. Because the laptop is nice (Arif, March 12, 2009).
>
> [I want to use the laptop] more akka. Because it looks nice and I will become intelligent (Amir, March 13, 2009).
>
> [I want to use the laptop] more akka…. (how much?)… 10 minutes more… (Only 10 minutes?)… [smiles] yes akka (Pradeep, March 13, 2009).

When asked explicitly why they wanted to use the laptop more, the children were unable to articulate in detail why, often smiling and blushing. They were also not able to clearly express how much more or why, but this was presumably due to their young age as well as their limited familiarity with English as a language of communication. I considered the possibility that this might also be due to their unfamiliarity with me. However, the child interviews were conducted towards the end of the fieldwork, and by then, students and I had already developed a working rapport, so I discounted this possibility.

In terms of their interactions with the laptop, children often sought approval and affirmation from any adult in the classroom including teachers and volunteers, shortening precious laptop session time. Some children wanted affirmation for completing even a single answer, others waited until they completed a group of questions, while a small minority worked independently and only sought inputs on completing their assigned work. The need for approval was also observable during non-laptop sessions, where children clamoured to be the ones speaking to the teacher or volunteer. I attributed this to the children's need for communication with older figures and role models since their parents might not be able to follow what the children learnt in school.

Children had developed a mental idea of whom they could reach out to for questions and help, and in their absence, others who could provide feedback. For instance, more children seemed to seek out the OLPC volunteer and computer teacher during laptop sessions to check their work even when the class teacher was in the room since many of their questions were laptop related as opposed to subject related. On the other hand, if questions were subject related, they immediately turned to the class teacher.

They also sought the class teacher to check completed work on the laptop. The OLPC volunteer, however, was the teacher most flocked with students and their queries during laptop sessions possibly because she stayed from the start of the session till the end and also functioned as the de facto technology "expert" when it came to the OLPC laptops. Munira, though the assigned computer teacher, only stayed for a short part of the session and hence was not as inundated as Veena with queries. Veena's name was constantly uttered by children when a screen hung, when they could not figure out how to navigate, when a file was not available, or when they made a mistake in their activity. This dependency was interesting considering that Veena is actually a volunteer external to the school system who by her regular commitment to the school and the laptop program had become synonymous with its functioning both among students and other teachers. When I asked the children whom they turned to for help or questions about the laptop, Veena often ended up being cited as the first go-to person. Munira and Lalita were also cited as important resources children turn to for questions.

> [I ask] Veenakka[14], Lalitakka, and Friends (Neeta and Pramila) [Sheba, March 11, 2009].
>
> [I ask] Veenakka, Lalitakka. They answer all (Neeta, March 13, 2009).
>
> [I ask] my Veenakka and Munirakka, Lalitakka, Reemakka, Runakka… (Arif, March 12, 2009).
>
> I raise my hand, sit in place… Munirakka, Veenakka, Lalitakka. I ask three of them also. When any akka is not there, I ask the other (Amir, March 13, 2009).

The type of questions children asked or clarifications they sought involved simple feedback needed to move on to the next part of their task. Other times, there were complaints about other children who were distracting them or not allowing them to use the laptops. Children were also impatient to get their questions answered so they could return to using the laptop, and it was not uncommon to see children pushing ahead of others to get their question answered first, or placing their laptops above others to stake

[14] When using the word "akka" to follow a name, children tended to attach it as a suffix to the name, conflating the two words into a single one. For example, Veena akka became Veenakka. It was also a more familiar, affectionate form of reference.

claim over the teacher first. In fact, even when children did not have specific questions, they wanted to share a new discovery or ask how to use a new feature discovered such as in the case of a boy who discovered the Paint activity and asked how to use the color feature to shade in a flowerpot that he had drawn. Even simply sitting in their places, children asked questions as teachers walked around the classroom.

> How to go up akka? [asking how to navigate with the scroll bar]
>
> What we should do akka? [in response to a hung screen]
>
> Akka, this girl stamping akka [when a child was trying to force her turn to use the laptop]
>
> But I have small one [question] akka [asking if her question could be answered before the children waiting ahead of her]
>
> Akka, finished! [seeking affirmation for having completed their work]
>
> Neeta, avalaghu kodi, ava madidare [a girl telling a friend in Kannada to share the laptop with her partner and give her also the chance to work on it]
>
> Akka, hand is paining, go akka [complaining that her wrist hurts from typing so much]
>
> Akka, akka, the arrow is not there akka! [looking for the cursor on screen, which seems to have disappeared for a minute]
>
> Akka, crocodile akka, see monkey [wanting to share the discovery of finding a new activity].
>
> Akka, you want to play akka? [offering to share the laptop]
>
> Akka, some problem [again, in response to a hung screen]

Clearly, the Venus class children seemed to consistently seek teachers' inputs during their learning process, highlighting the fact that teachers might be pivotal to the success of the OLPC laptop program. One reason for this could be that children's use of the laptop was not yet self-directed, possibly due to a combination of factors including

their age group, limited access to the laptops, limited prior exposure to computers, and newness of the laptop program at Yuva. While children had a certain comfort level with the laptops, they had not yet got to the point (excepting for a couple) where they could be left to independently direct their own learning with the laptops. Until the time children became comfortable with addressing the most basic issues themselves (both navigation and subject related) without having to wait for a teacher to be available to answer simple queries, a bulk of class time would potentially need to be spent on addressing logistical issues, reducing the overall time spent using the laptop.

Peer interaction could be channelled as one way to address this issue, since peer support seemed to already be taking place at different levels within and across the working pairs. Children very frequently asked each other questions, shared discoveries, and imitated what others were doing (such as opening the same activity or manipulating the interface in similar ways). Children also seemed to naturally slip into lead and follow roles when working in pairs or groups based on their personality, scholastic strength, motivation, and interest in the subject of laptop task. Of course, in some cases, this was productive, with slower students getting support to develop their own skills. In other cases, this led to problematic interactions such as negotiating for equal or greater usage time and stronger children moving away to work independently since they were getting frustrated being held back. Leaders and followers sometimes became impatient with the other and there was therefore a constant process of negotiation and re-negotiation taking place within partners and groups, and even across them with some children interchanging partners or verbally shunning them from their pair or group. This transaction-based behavior could be explained by the fact that the laptop program was still new and children were still exploring their roles, rights, and responsibilities as an ongoing process.

Another extension of the transaction-orientation was the variable willingness to share laptops and sensitivity to others' needs across class. There were children who consistently shared with their partners and those outside their assigned pairs. On the other hand, there were those who tried to retreat from the group format with a laptop (if they succeeded in convincing someone out of one), or without a laptop if they were milder in personality and could not negotiate for one. In cases where children branched out without

laptops, they often got disengaged from the activities in class and began to either sulk quietly or shift attention to another activity such as dancing or singing.

In terms of how children developed independent ideas and expectations around the laptop, I expected to see some degree of cultural adaptation to enhance the laptop's relevance within their context. However, while there were a few instances of adaptation such as the use of colloquialisms to refer to laptop activities and features, children for the most part used the actual names of activities and laptop functions (eg. booting, shutting down). Some of the adaptations witnessed included children referring to the TamTam suite of music creation and editing activities as the "keeky game", "dum dum game" or "kik kik game". On asking for elaboration, I found these were simply onomatopoeic formations of their own to refer to the fact that the activity is used to emit sounds like musical notes and drum beats. One boy had extended this formation to call one of the TamTam activities (TamTamEdit) the "ulta game" or "ulta kik kik". "Ulta" is the Hindi word for "upside down" and he presumably used this to refer to the more complex interface where in addition to the musical instruments, the interface also comprises a sound event sequence organizer. The different layout from the regular TamTamJam application could have contributed to his perception of it being upside down. Interestingly, these colloquial formations were only used to refer to activities that had been newly explored by the children themselves and never assigned for classroom activities. All activities used regularly both as a part of their lesson or as post-lesson activities were referred to by the actual assigned name of the laptop activity (eg. StoryBuilder, Maze, Slider Puzzle, Memorize) or in terms of what practical purpose the activity was used to serve (eg. puzzle, opposites, addition). Perhaps this was because they simply emulated the labels that the teachers used. For instance, had the TamTam activity been used as a part of their daily activities, children might have started to refer to it by its assigned name rather than devising their own labels. Clearly, there might be a difference in how children interpret and adapt to the laptops if left to their own devices and how they do so when guided. On the one hand, the guiding and support means that the children learn to use the laptop in conventional ways. However, in the process, this might preclude the possibility of children developing shared understandings of the laptop by

expressing their individual and collective cultural identities. This could be an important area of exploration in future implementations depending on the goals.

Interestingly, even after using the laptop for a few months and computers in the lab for a few months before that, children associated the larger purpose of computers simplistically as objects that allowed them to play games, watch movies, or work on English or Math assignments. They did not have a well-formed sense of what the purpose or potential of computers could be in a bigger picture sense. This suggests that explicit attention might need to be directed towards helping children develop a metacognitive appreciation for the various ways in which computers can be applied to address problems in the world around them.

> I asked them what is a computer. With the language problem, it was a little hard. Also they are very young. They said 'Akka, games, movies, akka'. This is all they know (Munira, March 05, 2009).

> [Computers are used] for writing… [Long pause and nothing else] (Sheba, March 11, 2009).

> [Computers are used] for games akka. Maths, EVS, writing, drawing (Arif, March 12, 2009).

> [Computers are used] to do something… [Thinks… looks confused and doesn't follow up with a comment] (Neeta, March 13, 2009).

> [Computers are used for] work akka, games akka (Raj, March 13, 2009).

> When I grow up I will use… for job… like Anand anna [one of the administrative heads of the school] (Amir, March 13, 2009).

The simplistic perceptions of the purpose of computers could be both due to their age as well as the lack of prior exposure to computers in their home environment. For instance, none of the children had previously owned a computer at home or came from a family with any exposure to computers. Even in cases where children had prior access to computers outside school, it had been self sought and involved paying money to hire a computer for a short time to play games. Only two boys out of the seven children interviewed claimed to have used a computer outside of school.

> Before laptop I had used computers in shops. You should go near… (thinks)… far… You have to give money and play there. My friends give money and I play games. It is five rupees for one hour. Car game, bike game, and train game (Raj, March 13, 2009).

> I have used with my brother in Krishnappa Layout 6th Cross. I paid money — 5 rupees. I can use for half an hour. That I played akka, that police game. One policeman and one terrorist. When police is coming to hit terrorist, terrorist will hit police (Amir, March 13, 2009).

Without any knowledge about computers, parents and family could not provide any support to children in exploring their own technological identities. Further, they would presumably be more concerned with pressing needs like securing food and healthcare. This put the onus for guiding technological inquiry in the hands of the school again, and more specifically, the teachers who already had a significant amount of responsibility within the school environment. In this context, this seems the only way that children can have the opportunity to develop a richer appreciation for the ways in which technology and daily life are co-constitutive.

Research Question 3: In what ways are the OLPC laptops used for instructional purposes?

The third research question asked in what ways the OLPC laptops were used instructionally. In observing Venus class activities and interviewing the key stakeholders, four aspects of teachers' instructional practices stood out. First, in comparison with prior computer use, the laptops were used to expose children to a greater number of activities and a greater variety in types of activities. Second, lesson tasks with the laptops were designed to support the curriculum and using a regular set of activities. Third, the degree of complexity and relevance of laptop features seemed to mediate which features were commonly used. Finally, teachers seemed to be engaging in processes of "routinizing" the use of the laptops within existing instructional practices. The rest of this section describes each of these four patterns.

With the arrival of the laptops, children were able to use computers more and a greater variety of activities were explored by teachers

Before the OLPC laptops were introduced to the Venus class in Yuva, computers were already a part of the curriculum. Exposure to computers at Yuva starts at the first standard level itself, and is gradually phased into the higher classes. While it is not an assessable part of the academic component of the syllabus, conscious efforts are made to integrate it with the curriculum. This involves the computer teacher working with the respective class or subject teachers to plan computer activities around their subject topics.

> All our children learn computers from grade 1 (Sarika, February 24, 2009).

> I show Sun class Tom & Jerry, Phonic Letters, ABC, etc. For Mercury, I do Snow White. There is also one website (www.starfall.com) that I take them to where there are many exercises and activities - making words, fruits, vegetables, climate, and animals. Mainly, related to their subject. If the teacher wants to show me something difficult, I bring them here and show it (Munira, February 20, 2009).

Before the laptops, the exposure to and the use of computers for the Venus class used to be only during identified blocks in the weekly timetable. The Venus class used to have two computer periods a week spanning 40 minutes each (see the highlighted computer periods in Figure 6, which shows the Venus class weekly timetable).

	9:30-10:10	10:10-10:50	10:50-11:30	11:30-12:10	12:10-12:40	12:40-1:20	1:20-2:00	2:00-2:40	2:40-3:20
	1	2	3	4	Lunch	5	6	7	8
Mon	Eng	Eng	Story	Kan		Math	EVS	PE	Music
Tue	Eng	Eng	Art	Art		PE	EVS	Math	Kan
Wed	EVS	Eng	Math	Yoga		Kan	Math	Eng	LS
Thu	Eng	Music	Math	Comp		Kan	EVS	PE	Kan
Fri	Eng	Eng	Comp	Math		Lib	EVS	Kan	Story
Sat	Math	Kan	Eng	Eng					

* Eng=English, Kan=Kannada, PE=Physical Education, Lib=Library, EVS=Environmental Science, LS=Life Skills, Comp=Computers

Figure 5 - Scheduled Computer Classes before the OLPC Laptops Arrived

During pre-laptop computer classes, children were taken to the school's computer lab, a single room located between the administrative and academic wings, comprising 14

desktop computers arranged along the periphery of the room. The computer teacher was responsible for planning computer activities and managing the computer sessions for children within the constraints of time, the number of available computers, topics that teachers asked to be covered, and children's age groups. The format of going to the computer lab was still adopted for other classes who did not have access to the laptops. Activities in the computer lab were planned based on grade level. For younger classes, computer-based activities ranged from games and drawing to educational multimedia activities run from CDs. Fifth and sixth grade students were introduced to Microsoft Office applications as well as email, chat, and Internet search.

> With the regular lab, they have a lot of educational CDs (30-40 CDs) - they put it and play with it. The LAN is here and in computer lab. There are 3 computers that are purposefully not connected to the Internet so they can work offline. Remaining all are connected. Activities they do are Mars - Paint, Jupiter - Internet (6th class). The children in Venus are too small to surf the net (Veena, March 04, 2009).

> Computer lab is also a change. Before the laptops also, we used to take them to the lab. They used to do Paints, Brainstorm (coins are dropped and they must hit the answer with an arrow). They get so excited - you have to see their faces. There they are okay doing with partners. They love sharing there (Munira, March 05, 2009).

> Before laptop, I used big one akka, computer, in the lab. I will do game, picture book. Akka will put Tom and Jerry, Munira akka. In my middle of school they have computer and I will do games. There will be one cat and balloons. That will drop and we should click. That will do "Dappp" and the answer will come (Arif, March 12, 2009).

> I'm use computer before akka. On January I used, akka, in computer lab, akka. I play the pictures akka. I play jigsaw puzzle, butterfly. I play one more, akka, that bike and tempo will come and take the stones, akka (Amir, March 13, 2009).

> Jupiter class teacher wanted me to show Tippu Sultan, Jhansi Ki Rani, African forests, science experiments, languages, grammar, crosswords, so I did that. For Venus class, it's not that OLPC is there, so every time OLPC is given. In older classes, they use Paint or Notepad or Typing Queen or Brainstorm [dropping balloons with educational problems]. They get very much involved in that. You should be calling 1000s of times and they won't even hear you. Jupiter and Saturn are the bigger classes

> and they use MS Word and PowerPoint. I am teaching them now how to make presentations using PowerPoint (Munira, February 20, 2009).

Going to the computer lab in the past involved getting into a line and being taken to the lab space (i.e., the environment of using computers used to be separate from the primary learning environment, the classroom [refer to Figure 1]). In the lab, computers were shared among students depending on the number of students in class and the number of free computers. If short of available computers, the computer teacher used turn taking to make sure that all children got a chance to work with the computers. The student to computer ratio could range anywhere between 2:1 to 4:1 in the computer lab.

> We have only 14 computers here and classes have 30-31 kids. So in 45 minutes, I take 15-15 kids. First 15 for 20 minutes and another 20 for the other kids. I keep the other ones busy during the time so they are also learning then (Munira, March 05, 2009).

With the arrival of the OLPC laptops for Venus class children, the student to computer ratio fell to anywhere between 1:1 to 2:1, although as pointed out earlier, 1:1 access was a rare treat and 2:1 access was most common. However, even though the drop in the student to computer ratio seems small, there was a considerable rise in the number of hours that students were given access to computers. With the arrival of the OLPC laptops, students got access to computing for six additional periods each week, amounting to a total possible weekly access of eight periods or 320 minutes (or five hours) a week. This was made possible due to the school's efforts to consciously integrate the use of the OLPC laptops into the existing weekly timetable, using the class teacher's "block periods" on Mondays, Wednesdays and Fridays for laptop sessions (see the revised weekly schedule in Figure 7 showing the laptop sessions highlighted in green in the timetable). Thus, on Mondays and Wednesdays, laptop use spanned a 2-class block period (80 minutes in all), and on Fridays, laptop use usually extended into a 3-class block period (120 minutes in all).

> I am here for maximum 2 periods on Monday, that is what, 80 minutes. I come in around 9:30 to 9:40 in the morning and I continue in the 3rd period sometimes. Wednesday is also similar. If there is something to copy I will do first in the morning or I will start off immediately. Friday, I have 3 full periods so we allow them to play and do whatever they feel

like. The breakup is Monday - English, Wednesday - Maths, Friday - English if possible and other activities and games (Veena, March 04, 2009).

We have about 6 periods a week (40 minutes each) spread over 3 days (Monday, Tuesday and Friday). So I would say we use it about 1 to 1.5 hours a day or say about 4 to 5 hours per week maximum (Veena, February 20, 2009).

	9:30-10:10	10:10-10:50	10:50-11:30	11:30-12:10	12:10-12:40	12:40-1:20	1:20-2:00	2:00-2:40	2:40-3:20
	1	2	3	4	Lunch	5	6	7	8
Mon	Eng	Eng	Story	Kan		Math	EVS	PE	Music
Tue	Eng	Eng	Art	Art		PE	EVS	Math	Kan
Wed	EVS	Eng	Math	Yoga		Kan	Math	Eng	LS
Thu	Eng	Music	Math	Comp		Kan	EVS	PE	Kan
Fri	Eng	Eng	Comp	Math		Lib	EVS	Kan	Story
Sat	Math	Kan	Eng	Eng					

* Eng=English, Kan=Kannada, PE=Physical Education, Lib=Library, EVS=Environmental Science, LS=Life Skills, Comp=Computers

Figure 6 - Revised Timetable showing Block Periods of Laptop Use

Thursday's computer class is shaded differently (in blue) since the laptops were not used during this session during the month-long period of observations. Instead, typically, on this day students were taken to the school's virtual classroom and shown movies, cartoons, and educational films. Essentially, what was earlier the computer lab period seemed to now be functioning as an A/V session. For example, during the month of observation, the films played included Madagascar and Superman. On Thursdays, children still "went" to computer classes, but instead of the lab-based computer activities that used to be the norm before the laptops, Venus class was now shown movies. Presumably since they used the laptop on other days, the computer teacher found it logistically easier to handle an A/V session for 32 children in 40 minutes rather than an excursion to the computer lab. Movies were selected based on what was available or donated, and included cartoons, "survival" films (set in Africa), and even films in the regional language, Kannada.

> The children want variety, so something new each time. If you show the same thing twice, they say 'akka, why you are showing the same thing?' (Grace, February 19, 2009)

> … all these days the children watched movies (in the virtual classroom). Only after they got laptops, they started using (Lalita, March 12, 2009).

Apart from getting to use computers *more* times each week and for *more* hours, there was also a greater *variety* of activities that students now had access to with the arrival of the laptops. While they were earlier exposed to games, basic computer navigation, and typing, children now had access to a suite of activities on the OLPC laptops designed with specific pedagogical purposes in mind. Many of these were preloaded on the laptops while others were installed during operating system upgrades or individually downloaded by the computer teacher and OLPC volunteer. Table 6 lists the various activities and learning features available on the laptops with their function, and indicates which of these were being used at Yuva and how frequently.

Table 6 - Major Educational Activities on the XO Laptops and Frequency of Use

Activity	Function	Used	Frequency of Use
Write	Word processing	√	Always
Paint	Drawing and painting	√	Occasionally
Browse	Web browsing	×	Never
Record	Picture, movie, and audio capturing	√	Seldom
TamTam Suite (TamTamJam, TamTamEdit, and TamTamSynthLab)	Composing, editing, and synthesizing music	√	Occasionally
Memorize	Memory-based pattern matching	√	Always
Chat	Synchronous text chatting	×	Never
MaMaMedia Learning Center (Story Builder, Slider Puzzle, Jigsaw Puzzle, Poll Builder, Cartoon Builder)	Games to express creativity and imagination	√	Always
Maze	Working through a labyrinth	√	Occasionally
Calculate	Calculator	×	Never
Turtle Art	LOGO-based programming language	×	Never
Etoys	Learning through programming	×	Never

Activity	Function	Used	Frequency of Use
Distance	Finding the distance between two XO laptops	√	Seldom
Mesh network	Group and community collaborating through the XO laptop	×	Never
Measure	Measuring and exploring physical phenomena such as light and heat	×	Never
Ruler	Measuring surrounding objects	×	Never

Note.

Frequency of use is conceptualized as follows:

- Always = Every laptop session
- Often = Multiple times each week (more than once each week)
- Occasionally = At least two times a month
- Seldom = Randomly explored or used but very rarely
- Never = Unused

As seen in Table 6, compared to their earlier use of computers, with the laptops, children were exposed to a wider functional range of computer-based tools such as word processing, drawing and painting, photo and video taking, memory and pattern-matching games, creativity games like puzzles, and developmental activities like story building. The greater variety provided the chance to develop skills and knowledge in previously unexplored ways, but whether this happened (as well as how and why) is explored further as part of another set of themes pertaining to the instructional use of the laptop.

In addition to learning subject lessons using the laptops, exposure to the laptops provided the opportunity for the children at Yuva to learn *about* new technologies, introducing them to new forms of navigation unique to portable computers that are not seen on a desktop computer (for instance, the touch-based mouse pad).

> Before the laptop, I would take them to the lab and show them how to type and work with the keyboard, erasing, shift, Caps Lock, etc. Paint and Writing also... Arrow keys also. They were familiar with the keyboard but not the mouse. When I gave them the laptop, they said, ‘akka there is no mouse!’ I taught them. They find it easy now. (Munira, March 05, 2009).

A regular few laptop activities were used to design tasks supporting curricular goals

Even though the OLPC laptop comprises a whole suite of educational activities, only a select handful was being used during laptop sessions at Yuva. Perhaps the allocation of laptop use only for English and Math and within the Long Range plan for those subjects constrained the scope of the instructional activities that were.

> Everything we do it is basically for English and once a week for Math (Veena, February 20, 2009).

> We have to tie it to the syllabus and not do the activities separately. So in the teacher's English or Maths period, we use it to combine the laptop activities (Veena, February 20, 2009).

> First we had decided to use only for the English. We didn't go much in that. We were new in that. So *Write* and *Memorize* was used, the ones we learnt as we went along. Veena was new. I was the one who started to do everything alone. After Veena came, then 1 month later [the Information Age Foundation] came with 25 other laptops. When Veena joined me, we decided to add more. We go to a website and download activities. We do opposites, plurals, many such activities. Then Math got added (Munira, March 05, 2009).

> We also incorporate the laptop with the class activities, not just on its own. We use it to ask children to solve both direct and indirect questions so that it encourages creative thinking (Shubha, February 20, 2009).

> I think the laptop combined is a good thing with the curriculum. It should not be used in isolation. Otherwise what is the point (Runa, March 04, 2009).

Even though teachers all agreed that the laptops should be used in conjunction with the curriculum, they seemed to recognize the lack of free-reign sessions that could potentially encourage creative exploration and thinking. The computer teacher and OLPC volunteer tried to include new kinds of activities for children to explore even within the current time limitations, but did confess that they would like to see more creative freedom given to children.

> Sometimes I do create my own [activities] and ask them to do it. I feel sometimes there should be changes. About 2 to 3 months ago, I gave the laptops and asked them to do what they wanted to do. Jigsaw Puzzles,

> games, typing fast. I observed what they were doing and addressed any doubts… That session, it was a chance to observe, see what they are doing on their own, what they like to do. It's not like you are instructing them to do as they are given (Munira, March 05, 2009).

> They will be wanting to do their own thing, create on their own. The clippings on the camera, they are very much fond of clicking their own picture. We didn't show them, they found it on their own. It was very nice. Amir and Sharya or Noor by accident pressed the key and it came all of a sudden. They were so thrilled they were saying, 'Akka, see, you are here. I am there.' So they were so excited. That time I just told them, you will be taken somewhere to click some pictures. But we have not been able to do that yet. No time (Munira, March 05, 2009).

> In a week, at least once, we should allow them to explore. They [the laptops] won't crash. If they crash also, we can upgrade. I have the software on my pen drive. We will be free from March end/April middle when they have exams so we can use that time to do that [upgrade the software] (Veena, March 04, 2009).

In contrast with the OLPC volunteer and computer teacher who saw the value of more free exploration, the class teacher wanted to ensure that she did not lose her block periods. Therefore, her focus was on using the laptops as a tool to support the ongoing curricular plan. Not falling behind on subject coverage timelines seemed to be one motivation of the class teacher in her choice to subordinate free laptop exploration in favour of achieving weekly and monthly Long Range subject goals. Even when it came to assessment of laptop activities, Lalita focused on checking and assessing the *content* of the lesson task rather than *how* the solution was executed using the laptops. This seems to be have been an example of a situationally constrained choice (Cuban, 1986) that Lalita made to balance the demands of fulfilling her job description while at the same time integrating laptop use within her weekly class routine.

> Whatever I have in curriculum, I am focusing only that. Actually I am giving my regular periods (subjects) to practice on the laptops. So far I have not fallen back, because now they are not focusing on finishing something but learning the concept well in the school. The continuous assessment helps. We don't assess the laptop sessions because other classes don't use, no? (Lalita, March 12, 2009)

> Whatever I teach na, match the following, fill in the blanks, we are doing. Nothing creative they have done, or we have allowed them to do (Lalita, March 12, 2009).

> For me, after finishing on laptop, I have to revise and tell them to copy in the class work (notebook) and I check that to see if they have understood. Both practice I can give (Lalita, March 12, 2009).

Lalita also worried how the laptops would affect children's handwriting skills, which were just developing. Since children had to pass ongoing continuous assessment as well as an end-year progress assessment, both of which involved handwritten work products rather than typed-up ones, this worry seemed reasonably founded. However, the limited hours of usage might not pose a problem at all.

> At the same time, with the laptop, they will lose the practice of writing. Right from this age if we provide computers, they might lose that ability to write well. Even the simplest concern, even the handwriting is spoilt. This could be a long run effect. It may help for the coming years if everything is online. In the future, who knows, right from Sun class (UKG) they will go for computers (Lalita, March 12, 2009).

The OLPC volunteer tried to use Friday's three-block period as a chance to introduce activities and games outside of the curricular areas she was expected to cover. Due to this, children seemed to have learnt to use a few laptop activities apart from the Write word-processing activity, which was the default used for all lesson tasks.

> Friday, I have three full periods so we allow them to play and do whatever they feel like. The breakup is Monday - English, Wednesday - Maths, Friday - English if possible and other activities and games (Veena, March 04, 2009).

> The maximum of the activities are in Write (February 20, 2009).

For students, the use of Write gave them the chance to use word processing in the context of a subject-specific learning goal. In the long run, this could help children map the function of word processing to the real world, where it is used as a productivity tool to support particular presentation and output goals. Apart from the assigned laptop activities, children had also been introduced to specific other activities on the laptops that they were allowed to work on once they completed their assigned tasks. While these were

essentially educational activities, they were presented in the form of "games" that children could play.

The activities children commonly played or opened to explore included the Memorize pattern-matching game, another set of games within the MaMaMedia Learning Center including Slider Puzzle, Jigsaw Puzzle, and Story Builder, as well as the Paint activity. One activity, Maze, which was only available on a few upgraded laptops, was also frequently explored by children and sought by those who did not have it installed on their laptops. Apart from Write, the Memorize activity was a laptop feature that teachers had explored beyond simply the default inbuilt activities. For instance, the OLPC volunteer and computer teacher had created their own pattern-matching games on Memorize, which allows for the creation of custom games by specifying logical patterns and a matrix size for the game.

> After September, the progress has been very good. At first, we tried the Memorize games and they caught on. We then created our own — I will show you — the application allows you to do that. Each level has complexity then they go to the next level. They are allowed to play for 30 minutes. They enjoy that. Jigsaw is another game they play which is basically solving puzzles which are downloaded from the OLPC wiki (Veena, February 20, 2009).

The degree of complexity and relevance of laptop features seemed to mediate which activities and features were used

The Write activity had become an integral part of day-to-day instructional activities with the laptops. Teachers seemed comfortable with this activity, perhaps since the empty-canvas Word processing interface resembles the Microsoft Word interface that they were familiar with on regular computers. This suggested that another factor might contribute to whether inbuilt pedagogical activities were used by teachers or not — namely, their degree of complexity (or ease). For instance, teachers found that they struggled to learn activities with markedly more complex interfaces and purposes, resulting in their not being used for lesson activities. In turn, teachers felt that children might also be too young to comprehend the more complex elements of certain activities and could run into roadblocks using them. Story Builder, Turtle Art, and the TamTam suite of activities were examples of applications that teachers admitted to finding difficult

to integrate with lessons, either because they found them difficult to learn or because they believed children were too young to grasp the complexity of embedded concepts.

> There is one Story Builder but I have not even touched it. No time (gestures with hand). There is also the TamTamJam music application. See, I am not a musician. I don't know how to use the keys and all like that. I asked my daughter — she is an engineer — to help understand the software, how to compose it and set it up. There are three things — Mini, Edit, Synth Lab. So the children open it and explore just like that. For this, I need someone to help me. This is one big challenge I am facing. I have not even touched many of the other applications because I don't know how to use and where to start. Plus, some are for older children (Veena, February 20, 2009).

> There are some interesting activities — Maze, Slider Puzzle — other things for higher level, higher classes (Veena, March 04, 2009).

Further, although Veena knew how to use Turtle Art, based on her familiarity with the students' existing knowledge levels and the year-long curriculum plan for Math, she felt that the activity was best left for when the children were at a higher grade level. Even Munira was only planning to introduce Turtle Art at a later stage, perhaps in the following academic year. The fact that this activity was only being used by sixth grade students in another school in the city was also cited as one reason why teachers did not feel a sense of urgency to introduce it to younger children.

> Turtle Art — they are too young, I can do Turtle Art/LOGO very easily because I am basically a programmer. So that one will be easy. But it is for older children (Veena, February 20, 2009).

> Maybe they'll be doing Turtle [in the next year] and…. I have not thought exactly. As I have been to the workshop, I saw kids in [the other Bangalore school] doing good pictures with Turtle and all. I guess next year they will be able to do it if I show two or three sessions how to do it even though the level is being done by sixth standard children at [the other school]. The good thing is when you teach A, you wont know they will say B or C, so that level of advanced thinking is there. It makes things easy. They answer more than you will expect (Munira, March 05, 2009).

Lalita in particular, felt that teachers' lack of comfort with many laptop features (including her own) limited their ability to expose children to a variety of features within short timelines. She pointed out that time and self-learning were necessary for teachers to

be able to learn to use the laptops more effectively themselves, and only then would they be able to use them effectively with learners.

> We have introduced. We must get used to that, then we can focus on curriculum (Lalita, March 12, 2009).

> I think we can try more. Only in the initial stage we have done. There are many things. We must learn first and then only teach them. And you have seen the kids. When they have done one, they very soon want to go for the other. So they are sharp (Lalita, March 12, 2009).

> Even I am very much new to it. Even I don't know how to use properly. Along with the children, I am also learning so later we might do [creative free-reign activities] (Lalita, March 12, 2009).

> We are in first stage no? So we don't know how to use more way (Lalita, March 12, 2009).

One activity that the computer teacher and OLPC volunteer unanimously felt would be problematic for children of this age to use was the Chat activity, which is a synchronous text chat tool that allows children to collaborate over a mesh network. Apart from the young age of the children, the computer teacher was concerned that the use of the chat feature for peer-to-peer chatting might not be very productive (as with the unproductive interactions witnessed in general laptop use) since the children were not yet comfortable enough with the laptops for their learning to be self-regulated. She did, however, see value in their using the Chat feature to communicate with teachers or those who could guide their learning more productively.

> Chat is too much for them even though Mr. [John] told me we could use the Chat application on the mesh network. I should try that for Venus class. I have to try and upgrade and figure out what to do (Veena, February 20, 2009).

> Chat will come soon. To improve their language and making sentences correctly it will help. We can do it but not with their friends but with volunteers, teachers, or me. From next week maybe (Munira, March 05, 2009).

An important feature of the laptop that had not been explored was the Internet, which the teachers again believed the children were too young to use. This could be

because they, like the computer teacher, saw the value of scaffolding in terms of introducing activities one by one rather than all at once.

> No Internet now — still they are learning. They should go step by step like learning to climb stairs. Not that as soon as you get the laptop you should open the desktop and say, 'now do it!' One by one we will add activities (Munira, March 05, 2009).

> No, the kids are too small (Veena, March 04, 2009).

Another unique feature of the OLPC laptop is its sharing features that allow children to collaborate over a mesh network using various neighbourhood views including a group and community view. Children can open one of these views to get a quick snapshot of what activities their friends and classmates are working on and also join into any of those activities by requesting to be added to them. The OLPC activities are designed to allow collaboration, and in fact, some are explicitly designed to require each shared user to make a contribution before allowing the next user to make their move in a task or game. Interestingly though, none of these collaboration features were being used at Yuva, since they were again (similar to the Chat and Turtle Art activity) viewed as more advanced features that children would only be able to appreciate when they were older or more experienced with using the laptops.

> I think what is easy is that a 2-way sharing is there in laptop also. That is a good feature. We have not done about the neighbourhood still — first we are doing basic and then we will add extra. I don't feel there is any difficulty. Till now it is just fine (Munira, March 05, 2009).

> That is very simple [the collaboration feature]. I will show you. See this computer? It will show the online computers around me and I can see who all are there online. Then I can say, Add a friend. For example, add Yuva 10 by saying Make Friend. They can chat also. Still, it's only for senior students but it is a good feature to collaborate. The same Memorize game, if they make friends, they will open one box then the partner opens the other. They have to wait for the friend to do (Veena, March 04, 2009).

The relevance of the laptops' features to the context of learning at Yuva also sometimes constrained how the laptops were used. For instance, this was seen in the case of the Hindi language option on the keyboard (see Figure 7), where a single button (the

AB key) can be used to toggle between language options. Children could not use the Hindi feature since they did not study Hindi as a subject in school. The official language of instruction was English and the mandatory second language was the official state language, Kannada. Unless children spoke Hindi as their mother tongue and they had learned to read and write it, this localization feature intended for the Indian market would continue to be unused. It might have been interesting to observe how a Kannada language keyboard option was used, had such a feature been available. However, the computer teacher was optimistic that the Hindi feature, while unused currently, might be handy in the future (perhaps if children learn the language or the curriculum allows for a third language or a choice of second language).

> It is a good thing we have the Hindi language feature in laptop. They don't have Hindi now so they would use that if they had it, but in future, we can use the feature (Munira, March 05, 2009).

Figure 7 - OLPC Laptop Keyboard showing the Hindi Language Option

Teachers implementing the program at the ground level seemed to be "routinizing" instructional practices with the laptop

Even less than six months after beginning to use the laptops, Lalita, Munira, and Veena (the three primary teachers associated with the OLPC laptop program) seemed to have developed a repertoire of routine practices that they had come to associate with weekly laptop use. This "routinization" was witnessed in how each seemed to have standardized the process of laptop use to align with both individual practices and goals as well as their collective program implementation goals. The routinization occurred along many dimensions: the nature and types of laptop activities and tasks, the nature of

assessment of laptop activities, the typical schedule of laptop use on a given day, and the instructional styles or approaches adopted.

In terms of the nature and types of laptop activities, assigned laptop tasks were most often oriented towards learning the "content" of the curriculum rather than real-world problem solving or creative exploration. Even simply learning new activities on the laptops was seen to be secondary to addressing subject objectives, although, teachers did try to accommodate the element of fun into the laptop sessions as well by allowing the use of games.

> Initially, when the laptops first came, we wanted them to learn the laptop interface, now there is a shift to subject matter (Veena, February 20, 2009).

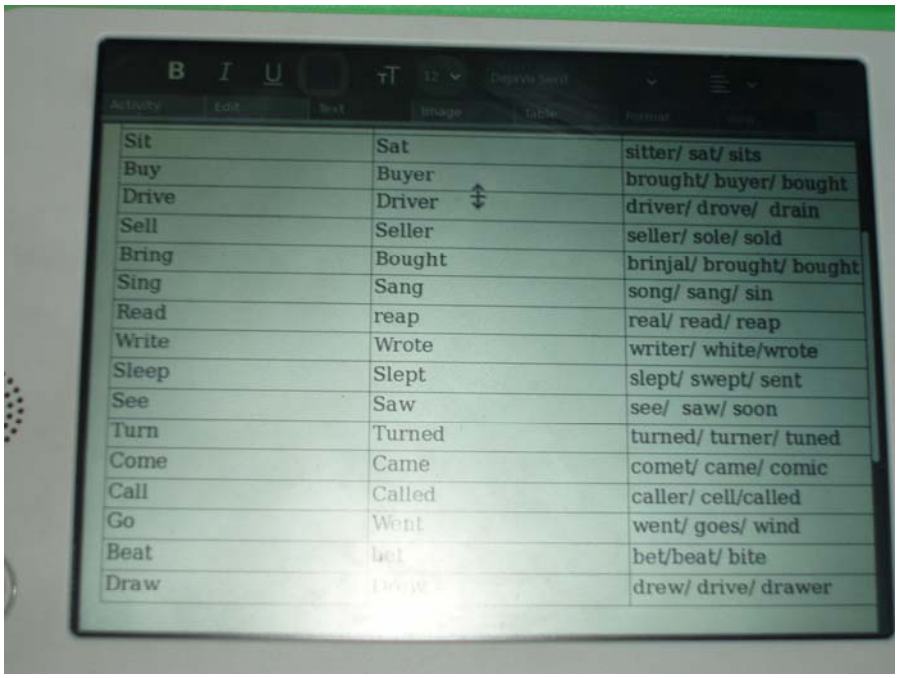
Due to the constraints of working within the syllabus and having to utilize block subject periods for laptop use, teachers possibly found it challenging to facilitate exploration of the laptop as a "fun" activity *and* use it as a tool to support learning in the pertinent subject areas. Usually, the computer teacher and OLPC volunteer ended up working with the class teacher to identify relevant activities to download or design to suit the subject topic for the week. Due to the multiple laptop sessions each week and the need to integrate these with specific subject lessons, Lalita, Munira, and Veena had jointly slipped into a routine where they consulted at the end of each session to plan for the next. Planning was usually a session ahead or at the most, two sessions ahead.

> We work with the teacher to create the activities. Sometimes, we both (Veena and I) go to websites and use activities from there and give it (Munira, February 20, 2009).

> If they [teachers] want to they can [take the laptops home to prepare for lessons] but usually it is [Veena] and me who handles the laptop so the teachers are still not that much comfortable with it. I do get the chance to take it home. The laptops are in my charge only (Munira, February 20, 2009).

The nature of activities designed also seemed typified by teachers. Typical activities for English included exercises on animal sounds, comprehension, and grammatical forms such as nouns and verbs, tenses, or parts of speech. The choice of

these topics was purposeful, in keeping with the Long Range plan for the year for the Venus class, which was laid out by the Yuva Resources team based on the ICSE syllabus for the given class. The activities were either downloaded from the OLPC wiki or created by Veena on the Write activity. Veena created simple exercises that looked like an online version of a worksheet, and saved them as a file for children to open and use in class. The formats could include one or more of filling in the blanks, matching logical patterns or relationships, completing sentences, correcting incorrect usages, and answering questions (for samples, see Figures 8, 9, and 10).



Sit	Sat	sitter/ sat/ sits
Buy	Buyer	brought/ buyer/ bought
Drive	Driver	driver/ drove/ drain
Sell	Seller	seller/ sole/ sold
Bring	Bought	brinjal/ brought/ bought
Sing	Sang	song/ sang/ sin
Read	reap	real/ read/ reap
Write	Wrote	writer/ white/wrote
Sleep	Slept	slept/ swept/ sent
See	Saw	see/ saw/ soon
Turn	Turned	turned/ turner/ tuned
Come	Came	comet/ came/ comic
Call	Called	caller/ cell/called
Go	Went	went/ goes/ wind
Beat	bet	bet/beat/ bite
Draw	Drew	drew/ drive/ drawer

Figure 8 - Sample English Task (Past Tense) using the Write Activity

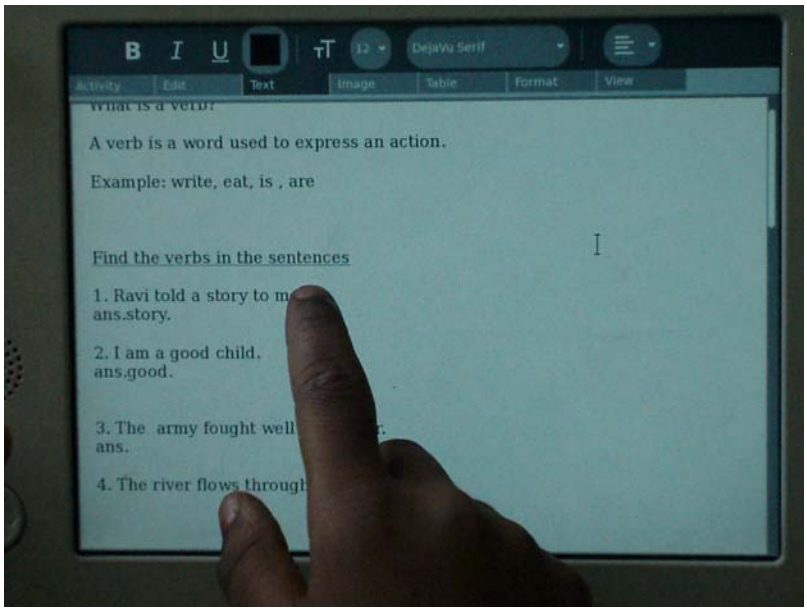


Figure 9 - Sample English Task (Verb Identification) using the Write Activity

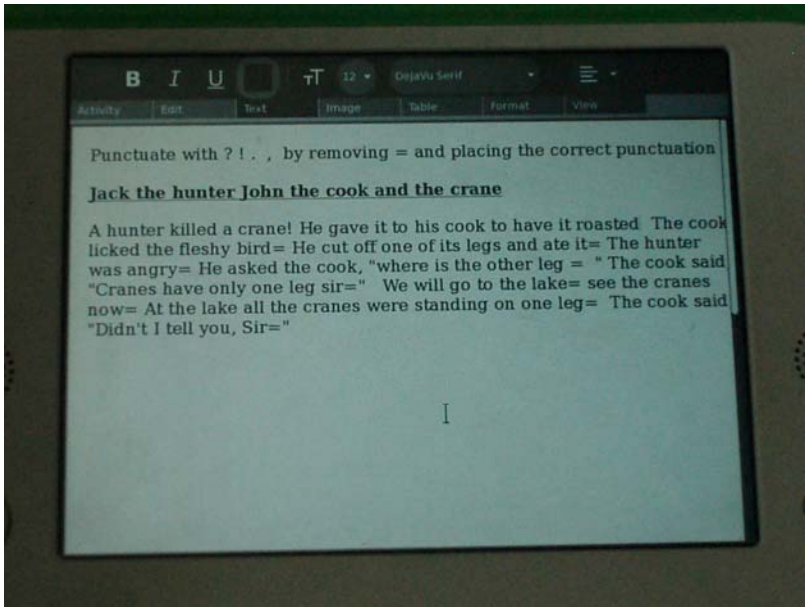


Figure 10 - Sample English Task (Punctuation) using the Write Activity

For Math as well, lesson exercises were created using the Write activity. The majority of past exercises focused on different addition, subtraction, and multiplication puzzles and word problems as well as other miscellaneous concepts such as ascending and descending numbers. Interestingly, rather than explore any of the other pedagogical tools on the laptop such as the Distance activity or Turtle Art to cover basic mathematical

concepts, the lack of familiarity with these tools meant that the Write activity ended up being used, again similar to a physical worksheet (for a sample, see Figures 11 and 12).

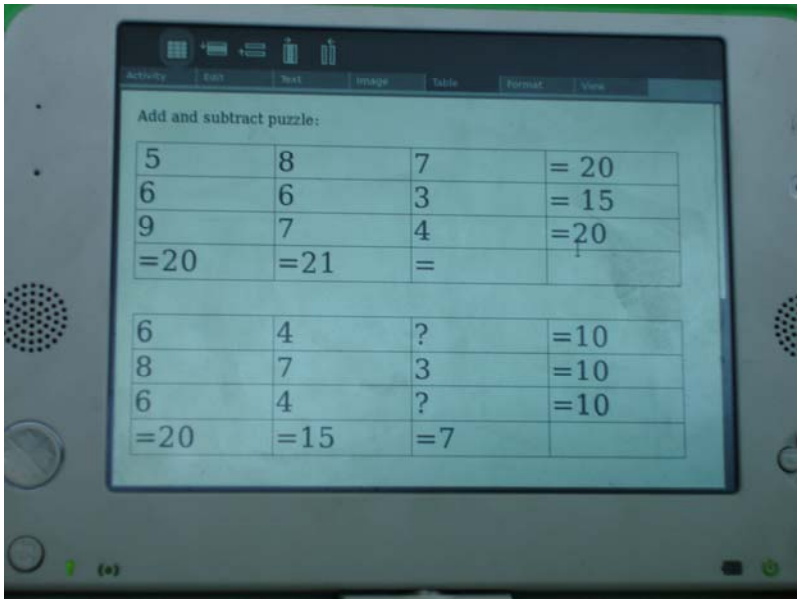


Figure 11 - Sample Math Task (Addition/Subtraction) using the Write Activity

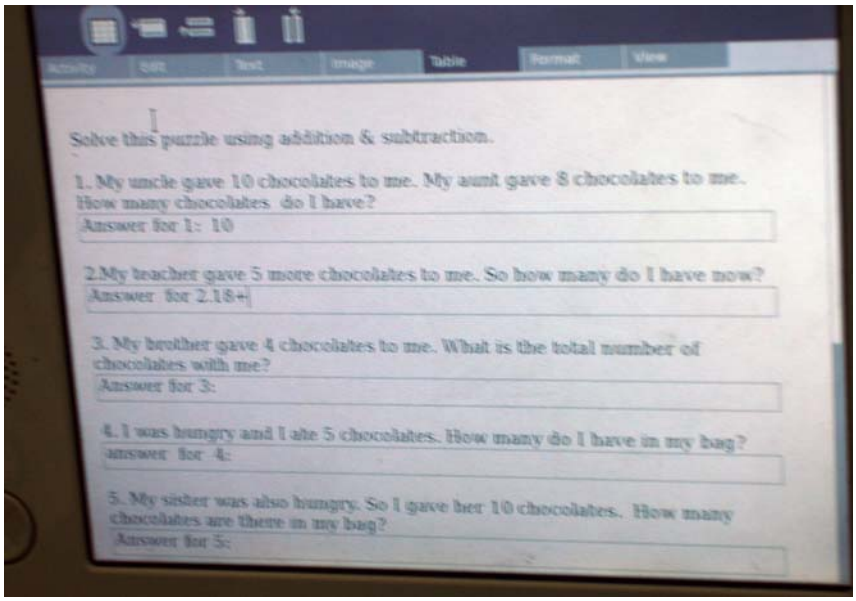


Figure 12 - Sample Math Task (Word Puzzle) using the Write Activity

In terms of lesson planning, teachers had also habituated certain practices and made them replicable on a session-to-session basis. For instance, the OLPC volunteer had standardized the process of bringing the designed lesson activities on her pen drive and loading the files on each laptop just before or at the start of the session.

> I am here for maximum 2 periods on Monday, that is what, 80 minutes. I come in around 9:30 to 9:40 in the morning and I continue in the 3rd period sometimes. Wednesday is also similar. If there is something to copy I will do first in the morning or I will start off immediately (Veena, March 04, 2009).

> For now, I carry zip files in my pen drive and read OLPC News and used to download activities from the wiki (Veena, February 20, 2009).

> I load files before only if possible, otherwise, I will do the same day (Veena, March 04, 2009).

Veena also followed the process of checking students' understanding of the content of the laptop task as she presented the lesson task for the day, and made a practice of repeating specific activities if many students faced difficulties with them.

> Some children do fast, some are medium pace, some are slow. If the whole class does not understand, it (the activity) is repeated (Veena, February 20, 2009).

Lalita, the class teacher, had standardized a process of assessment of laptop activities that worked within the confines of her goals of covering the Long Range plan and administering activities using the laptops. Rather than keep track of students' progress in developing computer skills or their creativity with the laptop activities, Lalita confined assessment to checking that students had completed the activity and got the "right answers". She did this by having students copy down their completed work from the laptop into their subject notebooks. The notebooks were corrected either during the laptop session itself or during another block time Lalita set aside for corrections. This process worked well for Lalita in terms of adhering to the practice of continuous assessment that the school adopts. Lalita also believed that the process of copying down the laptop work would be advantageous to the children since they did not get to keep their digital files considering that the laptops stayed in school. One potential challenge with this practice was that since the teachers write down the answers to the laptop tasks on the blackboard towards the end of class, they have to trust that children are copying down their own answers from the laptop as opposed to the correct answers from the board.

Another aspect of assessment not related to individual performance but rather to the overall monitoring and evaluation of the laptop program was maintaining documentation about the process and progress of the laptop program. This was one area that seemed lacking, potentially due to the newness of the program and the limited hours of use of the laptops. Munira, the computer teacher, pointed out that she had not been keeping a journal of laptop sessions or reflections on how the sessions were received or what challenges they faced.

> So far I have not done anything [keep records on individual activities with the laptop on a weekly basis]. But I remember everything. It will just take one or two hours to make a record. I am very familiar, what we have done from day one, I remember. I cannot forget! (Munira, March 05, 2009)

CHAPTER 7 — DISCUSSION AND CONCLUSIONS

The findings of this work emphasize how social and systemic factors shaped how the OLPC laptops were used, and in turn how the introduction of the laptops reconstituted stakeholders' practices and expectations around technology. Learners, teachers, and administrators associated with the laptop program all had to negotiate and reconstruct roles, responsibilities, communication practices, goals, and values in different ways. For instance, children adopted various transactional negotiations to assert their time and space with the laptops, the school management developed ways to address the internal inequality posed by the limited number of laptops, teachers developed a carrot-and-stick approach to manage negative social dynamics, and stakeholders in general constructed a shared routine around planning and implementing laptop sessions. Further, participants also constructed unique associations with the laptops within a short time of the laptops being introduced. The class teacher called herself an "L Board" to characterize her low comfort level with the laptops, the computer teacher likened the laptops to a miracle and magic, and the Venus class children heralded the laptops as all their own.

We also saw a collective lack of knowledge among all stakeholders about the pedagogical philosophy and design ideology of the OLPC laptops. Reasons for this include the lack of initial training on these factors as well as teachers' lack of self-learning in this area due to low technology comfort levels and time constraints. The reason this is important is because it tells us that even when technology passes hands, all the inherent assumptions and ideologies associated with its design cannot be expected to automatically pass hands with it. Without an understanding of these assumptions and ideologies, users seem to construct their own ways of adapting technology to their needs. In Yuva, for instance, teachers used the laptops to serve their goals of covering the subject-based curriculum in a structured manner. Instructional practices continued to be teacher-led, and the laptops often substituted printed worksheets rather than being used as a tool for "collaborative, joyful, self-empowered learning" (OLPC Mission Statement, 2009). Thus, even education-specific laptops such as the OLPC designed around a

constructionist pedagogical ideology can end up being used in altogether unexpected ways. This finding also suggests that gaps between intention and execution might be explained by closer inspections of technology as situated within a system with its own social, cultural, and transactional values (i.e., studying how technology is socially embedded and constituted).

One-to-one computing by Penuel's (2006) definition did not materialize on the ground in this developing country school for socially disadvantaged children. Simply providing OLPC laptops for a small group of children was not in itself sufficient to ensure that 1:1 access occurred on the ground or to inspire changes in instructional practices from teacher-led approaches to highly student-led ones. Considering that student-centered learning approaches are a key pedagogical goal of one-to-one computing and the OLPC, this finding is of importance both to designers of such pedagogical technologies and to practitioners purchasing the technologies for use in their contexts. Students did not have unlimited access to these laptops nor did they have any access to the Internet due to the lack of wireless networks at school. The laptops were not used on a daily basis as a productivity tool to complete home assignments and presentations. Thus, from the perspective of Penuel's definition of one-to-one computing, children did not have the opportunity to extend their learning with computing beyond the few hours' exposure in school for structured activity tasks.

Access turned out not to be a simple have/do-not-have binary and was mediated by various social factors. Stakeholders' expectations around technology were focused primarily on the value of the laptops for children from socially disadvantaged backgrounds. The instructional use of the laptop was routinized by teachers in terms of the schedule of sessions and the specific laptop activities used on a regular basis. The rest of this section discusses the implications of each of these findings. Following this, some limitations of this work are discussed along with directions for future research.

Access to One-to-One Computing

In the digital divide and equity rationales discussed in Chapter 2, we saw access to technology and digital services being conceptualized as a have/do-not-have binary. On

one hand, the access binary might be simplistically conceived in that it might exclusively focus on having or not having technology as a material property. On the other hand, it might be more holistically envisaged in that it might focus on the larger social implications and inequities resulting from the lack of access to information and knowledge. In both portrayals, access to (or the lack of access to) *technology* is attributed to be the primary catalyst for individual and developmental change. Yet, the findings from this work raise two critical and perhaps neglected questions. What can we take having access to mean? What aspects of access are decided by or constituted within a particular social context?

In this context, we saw that even with having access to technology, technology values, socioeconomic considerations, and social processes of regulation shaped the *nature* of access on the ground. For instance, these factors shaped whether the laptops were shared or used independently, owned by students or loaned to them for their use, provided for unlimited or restricted durations, teacher-supervised or student-led, and given to some students or all students. Further, these factors also shaped whether power and network infrastructure capabilities were feasible and whether knowledge and support were available to stakeholders implementing the program. Figure 13 is an attempt to illustrate the access considerations that emerged as being contingent upon context.

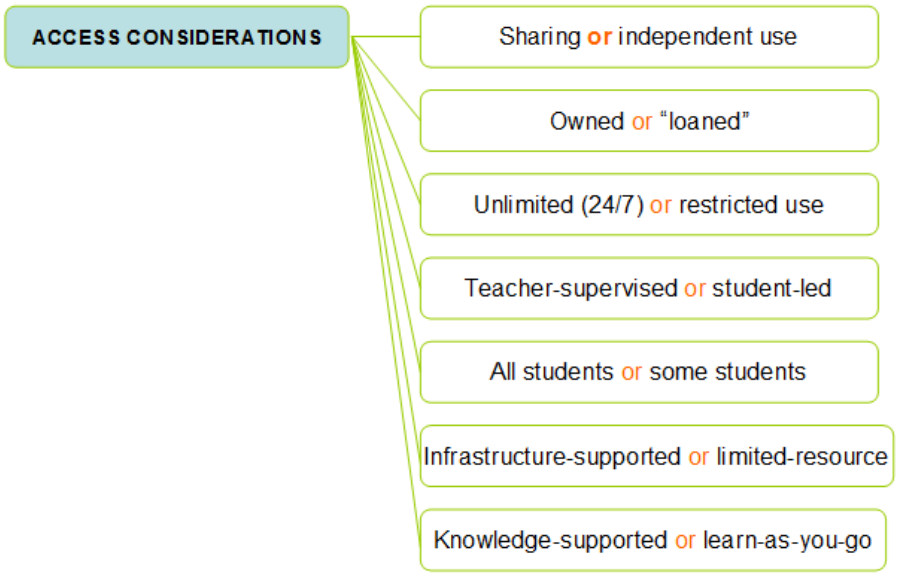


Figure 13 - Representing the Social Embeddedness of Access

Returning to the two questions raised, namely what access means and what aspects of access are constituted by context, this study shows the value of expanding definitions of access by drawing from grounded explorations of its manifestation. For instance, In Figure 13, I depict several access-related considerations. Social factors impacting decision-making around even a single consideration might influence how learners' and teachers' experience a given educational computing implementation. They might even ultimately determine what access models are feasible in given contexts: for instance, low-access, high-access, or one-to-one computing.

The rest of this section discusses each access consideration in relation to the social relations, structures, and dynamics associated with this context. In doing so, I aim to highlight the importance of including each of these considerations in defining access.

Sharing or independent use

As observed in this work, 1:1 independent use of the laptops was a rare treat for students. Sharing was a practical yet inevitable solution that teachers had devised to address the shortage of laptops. In choosing to follow the shared use approach, one trade-off was the unproductive social dynamics that arose from sharing. In particular, children were possessive and constantly negotiated and asserted "me time" with the laptops. Teachers consequently had a difficult time managing classroom dynamics from sharing sessions and often chose to use a carrot-and-stick approach, where reward and penalty were used to encourage good behaviour. Overall, teachers preferred 1:1 use mainly since classroom management and assessing individual contributions were problematic with sharing, while the OLPC volunteer preferred sharing since the logistical aspects of getting more machines ready were time consuming. Children were clearly highly engaged during 1:1 use but simultaneously displayed remarkably equitable attitudes about sharing. However, in the month of observations, only one 1:1 laptop session occurred, which provides only a single instance to compare against the more frequent shared sessions. These findings imply that not-for-profit or developing contexts might find a tension between working within their limited resources and yet capitalizing on the potentially beneficial social dynamics of 1:1 use. Future research in one-to-one computing in developing country contexts should potentially explicitly seek locations where 1:1 use is

actually occurring on the ground in order to better understand the social and learning processes associated with this ratio of use.

Owned or "loaned"

A key goal of one-to-one computing is to shift ownership and control for learning to the hands of learners. Ideally, this would mean giving full ownership of the laptops to learners. However, in this context, we saw that ownership was regulated. In effect, the laptops were "loaned" to students for their use within the school environment during specific hours. The majority of stakeholders did not feel comfortable with giving the laptops to children for their own. This was stated to be due to their age group and low socioeconomic background. For instance, children's families might not have the education or exposure to support children in working effectively with the laptops at home. As well, the cramped living quarters shared by large families and lack of basic infrastructural amenities in slums might also make it difficult to care for the laptops adequately, such as to store, clean, and charge them. Teachers were aware that children would also not be able to access power or power outlets, which would impede home use of the laptops. Despite these concerns, the management and administrators were considering future laptop ownership for the children. However, this might only be possible and relevant if in the future, electricity and power outlets become available to students in their homes. This raises questions about external dependencies on basic civic amenities provided by the local government and is tied to larger development policies.

Apart from ownership by students, even teachers did not have unlimited access to the laptops to develop their own comfort levels with the hardware, software, and pedagogical capabilities. Without attention to this aspect, teachers might continue to feel that they only have "L Board" competence like the class teacher pointed out.

Unlimited (24/7) or restricted use

Contrary to the 24/7 exposure that one-to-one computing aims to achieve, children at Yuva only used the laptops for four to five hours each week. Thus, while unlimited, all-the-time access to laptops is an explicit goal of one-to-one computing as Penuel (2006) defines it, this was not possible at Yuva for two primary reasons: the first

being the problems associated with children taking the laptops home; and the second being the priority for teachers to cover weekly subject topics on the Long Range curricular plan. The school consciously administered the duration, frequency, and times of using the laptops. Even though the school was clearly making conscious attempts to provide much greater access to computers than previously (i.e., the Venus class had almost four times as much access to computers than before), they had to deal with practical curricular challenges like making sure subject topics were covered fully. A similar implementation in a school for children from high-income families or one where the curriculum was explicitly designed to include the use of the laptops might have been able to consider unlimited use.

Teacher-supervised or student-led

Teachers at Yuva felt the need to supervise children constantly when they were distributing, using, and returning the laptops. Supervision was deemed necessary to handle negative behaviors including rough handling of the laptops and picking on other children. These behaviors were attributed to both psychological and environmental factors, such as learning disabilities that about 50% of children were diagnosed with and coming from abusive homes. While the socioeconomic and socio-psychological factors in this context seem particularly extreme, they point to the fact that these aspects need consideration when planning for one-to-one computing initiatives, particularly if the goal is to foster an environment conducive to student-led learning. Classroom dynamics were not the only reason for supervising children working with the laptops. The fact that the laptop sessions were integrated with subject block periods meant that teachers felt the need to prioritize the coverage of subject lessons and ensure that students were grasping key concepts in English and Math. While this is understandable, it again set up an environment of learning that was teacher-driven rather than student-led, which is at cross purposes with the goal of high-access computing models that are based on enhancing learners' agency.

All students or *some* students (equity concerns)

Equity was commonly stated to be an important decision-making criterion in school-internal policy decisions. While this applied broadly to all kinds of facilities and activities available to students, it also held true for the OLPC laptops. Stakeholders confessed that making decisions about access was challenging since they had to choose who got access to a highly desired amenity or facility, and how to deal with the internal inequality imposed as well as children's visible reactions to being left out. The principal and teachers seemed to work hard to avoid any kind of marginalization or segregation from opportunity. For instance, when the laptops arrived, the management was concerned that the deliberate targeting of one specific primary class would set up an internal inequity. Notable laptop programs in other parts of the world such as Maine's One-to-One Laptop Program in the United States (Silvernail & Lane, 2004) also specifically targeted one batch of learners (for example, one or two grade levels), but it could be argued that the background of Yuva's students warrants a more conscious effort to equity. In general, the staff at Yuva were all observed to consciously pay attention to "equalizing" day-to-day facilities available to children. This applied to meals, class supplies, and gift donations by external parties. The staff were so attentive to equality of access that even the Indian birthday tradition of distributing chocolates to classmates and teachers had been extended to distributing chocolates to the *entire* school so that other children in the school did not feel kept out or marginalized in any way. This equity focus also resulted in the allocation of a "special activity" for each non-Venus class after the laptops were donated to the Venus class.

One logical step might be to provide laptops to all learners. In fact, the first step the CEO pursued was to try to obtain additional laptops but this was not possible. Further, providing all students in a limited-resource school with laptops is clearly not economically feasible in developing countries due to the procurement costs and the efforts involved in sustaining long-term use. However, the school could consider a rotation program where the laptops are distributed among multiple classes for a certain number of hours each week. Since a large part of the week goes in laptop "downtime" (the actual breakdown in hours is discussed in the next section), their utilization might be better if they are integrated into the weekly schedule for other subjects and for other

learners. In having learners of different age groups working with the laptops, teachers and children alike could form networks of sharing and learning that could benefit the school as a whole.

Infrastructure-supported or limited-resource

At Yuva, we saw that the nature of infrastructural resources and support available directed to some extent how the laptops could be used. In this sense, access did not just pertain to the laptop as an isolated piece of technology but also to the supporting infrastructure and network services associated with its use. Without reliable power supply and facilities such as power outlets, challenges with short battery lifespan and the week-round charging necessity would surely persist. Power supply itself is an issue external to the school unless they obtain the resources or find it viable to utilize uninterrupted power sources or generators.

The provision of ample power outlets is one investment that can prove useful in terms of allowing for longer periods of laptop use and reducing the burden on the computer teacher to charge every laptop in rotation all week long. Twenty-four laptops in total need only two hours of charging time if there are enough power outlets (i.e., twenty-four in all). However, in reality, since only five power outlets are available to charge the laptops, the laptops need to be charged in five batches, each batch taking around two hours if the laptops need full charging. In effect, after every one to two hours of using the twenty-four laptops, there is roughly a ten-hour *necessary* downtime window when the laptops need to be charged to get them ready for the next session. It could be argued that the laptops could simply be charged overnight and be ready for use every morning (and perhaps then shared among other classes too). However, the manual process of having to unplug each set of five laptops and replace them with another five every two hours makes it unfeasible to complete the charging in a straight ten-hour charging slot since this would need someone to be available into the late hours of the night to make the switch between each batch. Thus, the downtime is further extended into subsequent days and might take as long as a 24 hour time window simply because of the need for manual support.

One way to prevent this extensive downtime is to increase the number of outlets available in the virtual classroom in order to accommodate all the laptops in one batch or at the most, two batches. This would considerably reduce the downtime to only about two to four hours at the most, thereby (theoretically) allowing at least two additional school days where the laptops can be used. Even within each of the five days of use, two blocks of laptop sessions could be planned, one starting early in the morning followed by a break for charging and then by a second block. Thus, with more power outlets, the laptops could be used for at least four hours every day or twenty hours each week (not counting Saturday, which is also a working day). This represents five times the current usage in terms of number of hours of utilization. Another efficient approach could be to provide at least five to ten power outlets in each classroom where the laptops are used and encourage children to use the outlets on a continuous basis or at least to charge their own laptops whenever required. This could again potentially enhance the utilization of the laptops. Further, it would address the comment raised by the volunteer who suggested that children needed to be more aware of the operating responsibilities associated with using the laptops. By recognizing that their use of the laptops would depend on their attentiveness to aspects like charging, children might develop a sense of ownership and a practical working knowledge around the laptops rather than use them impersonally.

Access to wireless Internet infrastructure represents another mechanism that is currently unavailable to children both in school and at home. Considering that children return to below-poverty-line homes each day, the only option they would have to access the Internet is at school. With the OLPC laptops' powerful collaboration features, inbuilt browser, and chat capability, it seems that the lack of wireless Internet services could be one factor limiting the exploration of the communication capabilities of the laptops. The availability of the wireless functionality could open many more avenues of learning for children and teachers alike.

Knowledge-supported or learn-as-you-go

The limited access to knowledge, training, and support for stakeholders implementing the laptop program was an important factor constraining effective laptop use. Due to the lack of formal external connections with the OLPC or the original local

distributors, stakeholders used a learn-as-you-go approach to self-learn laptop activities and develop instructional practices around its use. When faced with a roadblock (for example, finding an activity too complex, not having a latest piece of software, or encountering a technical glitch), the school turned back to the external distributor to seek a remedy, usually in the form of an email. The fact that initial terms and conditions were not laid out contractually placed no obligation on the part of the distributor to respond, and according to stakeholders, often they did not respond. Further, there was no formal OLPC-run mechanism that Yuva could use to seek this support or knowledge. Of course, teachers could use the OLPC wiki or join country-specific practitioner mailing lists to seek solutions, but at such an early stage of implementation, these informal mechanisms might need to be scaffolded by formal ones.

For a one-to-one computing program to succeed on the ground, Yuva should either consciously seek to develop internal expertise on the OLPC laptop so that training, software installation, and even basic technical issues can be resolved without reaching out to third parties. Current professional development programs could be expanded to also cater to training and support for laptop implementation teams. Alternatively, they could formally collaborate with an external support agency or group to handle these details. The OLPC and associated distributors in developing countries could help ease this challenge for schools by providing orientation, training, support, as well as formal information and communication channels to prevent the laptops from being perceived as just another consumer product as opposed to what they are intended to be — i.e., pedagogically-grounded learning technologies.

The external dependencies for support and training and the lack of local organizations that could provide these also raised an important question with regard to the feasibility of using the OLPC laptops in this context. Even though the OLPC positions the XO laptops as low-cost computers, their retail value is about 200 US dollars apiece. Considering that many other desktops and laptops are available for that price, many of which run more ubiquitous operating systems such as Microsoft Windows, it might turn out more viable for developing country schools to make an investment in such technologies due to the easier availability of local support and expertise.

Stakeholders' Expectations around Technology and the OLPC Laptops

The technology values and expectations of stakeholders at different levels of implementation translated in many ways into the ultimate use of the laptop. Many stakeholders interviewed in this study were unanimous in their views about *exposure* to the laptops for children from socially disadvantaged backgrounds. The opportunity to *access* the OLPC laptops was taken to be akin to a miracle or privilege for the children, since teachers believed that such an opportunity would otherwise have been out of the realm of their day-to-day realities. Several participants emphasized that the children went from a high awareness of the privilege of using the laptops initially to a more recent regard of the laptops as being something uniquely for them. The children's reactions to the OLPC laptops have implications with regard to the emancipative perception of 1:1 computing. While emancipation in the context of computer use has often been talked about pedagogically from the perspective of putting increased control in the hands of the learner (eg. Laurillard, 1987), in this context, the emancipative sentiment referred more foundationally to the thrill of having a previously unavailable opportunity. With the exception of the principal, stakeholders seemed to attribute an intrinsic emancipative value to the laptops themselves, which is a surprising finding considering that the value was often attributed at the level of access rather than specific pedagogical affordances of the laptops or instructional practices with it.

More specific technology values around the laptops were formed in a variety of ways, sometimes at the macro level of their impact, and other times at the micro level of implementation details. For instance, Sarika (the CEO) saw the laptops more holistically as a tool that could allow children further exposure to the world and new ways of thinking. On the other hand, Veena (the OLPC volunteer) was more focused on the details of everyday implementation with its capabilities and challenges. Even among the macro-level viewpoints, there were differences in how participants perceived the laptops as an educational tool. For instance, in contrast with Sarika who looked at the laptops in terms of their symbolic and motivational capacity, Priya (the principal) was pessimistic about the capability of technology to motivate children. Thus, even at the same level of

the implementation chain, participants expressed unique perspectives and concerns with regard to technology use in education.

The Value of Understanding Stakeholder Expectations

The findings from exploring multiple perspectives in this study suggest that it is important to pay further attention to these perspectives to understand how laptop programs like the OLPC actually get implemented on the ground and what challenges they can be expected to run up against. While ground-level implementers of the program (the teachers and OLPC volunteer) stated that students expressed greater interest in using the laptops as compared to their notebooks and were more immersed in their work while using the laptops, the principal felt that it was people and not machines that had the strongest potential to motivate students. Such contrasting value perceptions around technology's potential within a single system need to be carefully explored and compared before developing models of computing for use within them. They might suggest that there is value in a grounded approach to the design of laptop initiatives for children — namely, that the contextual needs are understood *first* and the technologies and surrounding systems are designed *after*.

We also saw an individual and collective "powerlessness" in terms of stakeholders' unanimous lack of confidence about the future of the program due to their limited access to OLPC-specific knowledge, infrastructure, and support. We saw teachers wondering at whether the laptops would be continued up with the current Venus class. We saw the OLPC volunteer concerned about procuring software and upgrades. The lack of technical support was a recurring challenge identified by all stakeholders. In addition, while the OLPC has an active and extensive wiki and the open-access nature of the content should be given credit, teachers confessed to not having the comfort level and skills to competently exploit dynamic social media to their full potential. All these findings have important implications in that they draw attention to the lack of ownership and responsibility on the part of educational technology design organizations and firms (whether non-profit or profit-oriented) when it comes to long-term integration. This is not to say that technology firms must be held responsible to address all these angles. Yet, it might very well be that even the most well-meaning pedagogically-grounded technology

could become just another market commodity if it is not packaged with the much-needed short- and long-term systemic support that developing country contexts might require.

The OLPC explicitly positions itself as en "education project" as opposed to a "laptop project". They advocate that the XO laptops will help inspire student-centered approaches to learning, and posit that it is a faster and more effective way to address developing country education needs than traditional approaches such as teacher development and infrastructural improvements (OLPC Wiki, n.d.). However, as seen in this context, the intention of creating a student-led learning environment did not automatically occur by providing OLPC laptops to learners. This suggests that an understanding of the social structures, relations, and values bound within a context as well as a conscious adaptation to these local needs is crucial to the success of 1:1 laptop programs. For instance, one potential direction for future implementations is to set up formal channels of mutual dialogue and exchange, where external stakeholders (eg. the OLPC) benefit from the local, particularized knowledge and concerns of internal stakeholders, while internal stakeholders get access to the knowledge, resources, and support that ensure the success and longevity of such educational technology programs. Participants in this context such as the computer teacher and OLPC volunteer did specifically express the need for linkages to other practitioners. In the long run, setting up such channels could be a strategic factor delineating technology vendors from long-term technology partners.

Instructional Use of the Laptops

This study revealed that many features and activities of the OLPC laptops were unexplored including the group and community collaboration features, the Internet, the Chat activity, pedagogical activities such as Story Builder and Turtle Art, and the Hindi keyboard language feature. Further, we also saw that the Write activity had become synonymous with lesson task planning. The way this single activity was being perpetually used to create simple online worksheets raises questions about the value of using the laptops if the same worksheets can be delivered by simply printing them off and supplying them to children. The use of the Write activity itself is not the problem, but rather the way it is utilized for lesson activity design. There could instead be value in

using the Write activity for the types of lesson tasks that require the manipulation of text or media that is not possible or more cumbersome to do physically. For instance, a lesson in composing paragraphs could involve children rearranging a set of jumbled sentences, for which the capability of the computer to easily move around text is an advantage. The physical equivalent would be to give each child cut up strips to rearrange, which is a scenario that would involve extensive pre-preparation in terms of laying out and cutting up all the strips. Exploring such uses of the same Write activity could potentially be of value in developing new digital skills rather than simply replicating what would otherwise be written on paper on the computer screen.

Moreover, there might be value in teachers exploring activities on the laptop that revolve around real-world problems so that children develop problem solving skills that will aid them in higher classes and eventually in workplaces (for example, developing information literacy skills, working with media, composing documents, making presentations and so on). Shifting instructional styles to a real world problem solving-oriented model as opposed to a declarative content-oriented one, however, involves big changes not just in instructional outlooks and approaches but also in daily constraints like scheduling which are beyond the control of teachers. Moreover, the nature of the central board-administered curriculum with its push for content coverage could also put pressure on the teachers to prioritize topics to be covered. Despite these constraints, it is important for teachers to critically question how each laptop feature can be used to its full potential. In the case of the Hindi language feature, some of the children know Hindi and speak it as a mother tongue, which indicates that there might be value in providing free expression time where children can express creatively in a language other than the first language of the school. For instance, allowing students to explore the Hindi language feature to create poetry, stories, or song lyrics, while not directly relevant to the Long Range curriculum, might be useful to help them become more independent and imaginative in their use of the laptop.

In order to support teachers to use the laptops in more meaningful, constructive ways, they also need to be provided with appropriate guidance both by the school as well as by the designers or distributors of the laptops. As seen in this study, although instructional practices were mediated by educational beliefs and constrained by the

complexity and relevance of laptop features, teachers were consciously working within the constraints by routinizing elements of their practice with the laptops. These processes of routinization witnessed might have implications from the perspective of fostering reflective practice, where the focus is to enable practitioners to consciously reflect on the assumptions and expectations shaping their practices in order to encourage a cycle of continuous reflection (eg. Loughran, 2002). It has been argued that teachers' grounding in the classroom environment and situations gives them classroom knowledge that is integral in shaping their practices (eg. Doyle, 1990). One way of looking at this is that knowledge is grounded in action (eg. Schön, 1987). But in order to extend this classroom knowledge to enhance their practices, teachers must be able to explicitly reflect on both favourable and problematic aspects of their practice. Reflection in action supports processes of continuous learning, allowing practitioners to further develop the ability to problematize and reflect (Schön, 1987).

Supporting teachers in becoming more reflective about their practices with the laptops could be one way to impact their practices. As reinforced by the findings from this study, beyond the introduction of technology itself, teachers and learners need to be given both the *opportunity* and *support* to develop advanced ways to learn, interpret, and use technology meaningfully in their daily lives.

> … computers in themselves do very little to aid learning. Their presence in the classroom along with relevant software does not automatically inspire teachers to rethink their teaching or students to adopt new modes of learning. Students' use of computers for various tasks — writing, drawing, or graphing, for instance — usually does not radically transform what they would do without computers, although it may make the enterprise more efficient and more fun. Learning depends crucially on the exact character of the activities that learners engage in with a program, the kinds of tasks they try to accomplish, and the kinds of intellectual and social activity they become involved in, in interaction with that which computing affords. Computer technology may provide interesting and powerful learning opportunities, but these are not taken automatically; teachers and learners need to learn how to take advantage of them (Salomon and Perkins, 1996, p. 113).

Limitations and Future Research

While this study allowed a reasonable amount of immersion in the context (a month), a new phenomenon like one-to-one computing in a developing country context would require further longitudinal exploration to understand changes over time. Cross-comparing emergent findings across contexts in naturalistic studies has been thought useful to gauge "the degree of fit between the contexts" (Guba, 1981, p. 81), or the extent to which the findings from one context are transferable to the other. Similar to exploring implementations over space, extending such case study work temporally either in terms of longer engagement in the site or repeated study over time intervals could indicate in what ways the findings stay stable or vary over time. Other methodologies to explore multiple perspectives and participants' lived experience such as ethnography might provide further understanding of OLPC implementations in developing country contexts.

The early phase of implementation of one-to-one computing at Yuva (i.e., the fact that it was only running its sixth month) might have contributed to some of the findings depicting individual and collective doubt. The only way to probe this issue more deeply is to conduct a repeated study at the same site after an extended gap, during which stakeholders would presumably have developed further knowledge around the laptops or used them in further ways instructionally. Further, while only a single researcher on site was possible in this study, another methodological variation to explore in future work could be to have multiple researchers on site. This could allow for the generation of further perspectives as well as the ability to engage in real-time dialogue on emergent findings while being immersed in the context.

Finally, since the focus of this work was to understand the post hoc implementation of educational computing to gain empirical insights, an important area left out of the scope of this work was a value scrutiny of whether young children *should* use computers for unlimited periods and what the short- and long-term consequences of prolonged computer use could be. In taking the empirical approach, in no way was this study ascribing to a position of technological determinism, in which technology is attributed as a transformative agent driving social change (Smith & Marx, 2001). Rather,

the focus was to use an available opportunity to understand how technology served the values and purposes of a group, as embedded within a social system.

Implications for Practitioners and Low-Cost Computer Designers

In exploring how one-to-one computing translates on the ground in a developing country context, this study highlighted several key findings of importance for practitioners as well as designers of low-cost computers for education. Above all, the findings demonstrated that paying attention to technology procurement or distribution without comparable attention to social and systemic factors could result in unexpected or less effective instructional uses of technology. This is particularly the case in developing-context school environments, where infrastructural resources are limited, local expertise is not easy to find for new computing platforms, teachers have little background and training in computers, and learners come from low-income backgrounds.

The neglect of contextual factors points to the gap between technology designers/technology program designers and their audiences, who do not share the same context (or even many similarities in lifestyle, culture, and socioeconomic concerns). Moreover, the gap between designers and end-users reinforces the outside-in nature of such programs, resulting in users not being able to view the technology's cultural relevance to themselves nor see its original underlying cultural ideology. Inevitably, as seen in this study, users ended up using the OLPC laptops to keep up existing pedagogical practices. In effect, in many ways the OLPC laptops simply functioned as a new modality for an existing practice (such as using instructional worksheets for Math and English). In their study of ICT trends in rural India, Rangaswamy & Toyama (2005) highlight the same problem of "urban technologists" (often from multinational companies or organizations outside the target geography) tending to form preconceptions about rural audiences that act as barriers to technology design. Perhaps similarly, the design of low-cost laptops lacks a holistic attention to cultural and social relevance, which hinders its effective assimilation and integration within specific social systems.

Importantly, this study also showed that functional and ideological values around technology cannot be taken to be universal, nor can they be assumed to be implicitly

understood or imbibed by users when they begin to adopt the technology. For instance, just because the OLPC laptop was designed around a constructionist learning ideology did not mean that it was actually used as the designers intended. Similarly, while in theory, the OLPC laptops were intended to be used in a student to computer ratio of 1:1, in practice, the extent and nature of access was mediated by social and economic factors as well as stakeholders' values — i.e., how much was optimal, how often was appropriate, who decided, and who got it.

Finally, using a case study approach was valuable in deeply probing the intentions and expectations of the multiple school stakeholders associated the OLPC laptop program. Extending this approach to explore the views of stakeholders outside the school system such as the local distributors, donors, and makers of the OLPC laptops would be the next ideal step. Doing so would help to build a more sophisticated understanding of the complex interactions and relationships associated with this and other educational computing programs.

While the immediate research directions for one-to-one computing are to continue to develop a rich and deep understanding of this model based on other developed and developing country implementations, subsequent work could also aim for broad comparisons across contexts using comparative case studies combined with survey data. Armed with both a *deep* and a *wide* understanding, we can refine theoretical frameworks of one-to-one computing with empirical grounding. In doing so, we suitably serve the diversity of different contexts while allowing for the emergence of grounded policymaking that has applicability in these various contexts.

APPENDICES

Appendix A: Interview Log

Date	*Interviewee(s)*	*Type*	**Duration/Location**
Feb 19	Library teacher/social worker	Short ethnographic	11.30-12.00 Virtual Classroom
Feb 20	OLPC volunteer, general volunteer	Preliminary semi-structured joint interview	11.15-12.30 Virtual Classroom
Feb 20	Computers teacher	Preliminary semi-structured	12.30-1.20 Virtual Classroom
Feb 24	Founder and CEO	Depth interview	1.20-2.30 CEO's office
Feb 25	2nd standard class teacher	Preliminary Ethnographic Interview	10.15-11.00 (2nd standard Classroom)
Feb 25	2nd standard class teacher	Semi-structured	12.40-1.20 PM and 2.10-2.40 PM (Staff room)
Feb 25	Principal	Semi-structured	3.15-4.15 PM (Staff room & virtual room)
Mar 03	Class Teacher	Semi-structured follow-up	12.50-1.40 PM
Mar 04	OLPC volunteer	Semi-structured follow-up	9.40-10.15 (Virtual Classroom)
Mar 04	2nd standard EVS Teacher	Semi-structured	11.50-12.10 (Staff room)
Mar 04	Social Worker	Unstructured	1.45-2.20 (Staff room)

Date	*Interviewee(s)*	*Type*	**Duration/Location**
Mar 05	Computer Teacher	Semi-structured follow-up interview	10.10-11.40 (Computer lab and virtual room)
Mar 11	Sheba (a 2nd standard female student)	Semi-structured spot interview in 3 phases	9.30-12.00 PM (as free in 15 minute phases) (Classroom)
Mar 12	Arif (a (2nd standard male student)	Semi-structured spot interview in 3 phases	9.30-11 AM (Classroom)
Mar 04	Pramila (a 2nd standard female student)	Spot interview (OLPC questions only)	12.30-12.45 (Classroom)
Mar 12	Class teacher	Semi-structured final interview	12.50-1.30 PM (Classroom)
Mar 13	Neeta (a 2nd standard female student)	Semi-structured spot interview in 3 phases	9.30-10 AM (Classroom)
Mar 13	Amir (a 2nd standard male student)	Semi-structured spot interview in 3 phases	10-10.30 AM (Classroom)
Mar 13	Pradeep (a 2nd standard male student)	Semi-structured spot interview in 3 phases	10.30-11 AM (Classroom)

Appendix B: Observations Log

Date & Time	*Role*	*Location*	**Participants**
February 19 10:20-15:50	Observer	Venus classroom, virtual classroom, school corridor and playing field	Venus class children, class teacher, EVS teacher, Kannada teacher, PE teacher
February 20 8:30-11:15	Observer with participation	Venus classroom and school playing field	Class teacher, computer teacher, principal, OLPC volunteer, Venus class children
February 20 13:30-16:00	Observer	Venus classroom	EVS teacher, class teacher, Kannada teacher, Venus class children
February 23	School holiday		
February 24 8:30-10:50	Observer	Venus classroom	Class teacher, Venus class children
February 24 10:50-12:15	Participant	Venus classroom	Class teacher, general volunteer, Venus class children
February 24 12:15-14:40	Observer	Venus classroom, playing field, lunch room	Class teacher, Venus class children, PE teacher, EVS teacher, Kannada teacher
February 25 9:10-12:10	Observer with participation	Venus classroom	Principal, class teacher, Venus class children, OLPC volunteer
February 25 12:10-12:40	Observer with participation	Lunch room	Class teacher, Venus class children and other class children, other teachers
February 25 13:20-15:00	Observer	Venus classroom and staff room	Class teacher, principal, Venus class children
February 25 15:00-15:30	Observer	Staff room	Principal, school teachers, some children
February 26 09:00-11:30	Observer	Chemistry lab hosting MultiLIT reading program	MultiLIT volunteers, child participants, class teacher

Date & Time	*Role*	*Location*	**Participants**
February 26 11:30-14:40	Observer	Staff room, Saturn class	EVS teacher, music teachers, Saturn class, class teacher
February 26 14:40-16:00	Observer	Venus classroom	Class teacher, Venus class children
February 27 09:00-13:40	Observer with participation	Venus classroom	Class teacher, OLPC volunteer, principal, computer teacher
March 02	Missed day		
March 03 09:00-14:00	Observer	Venus classroom	Class teacher, EVS teacher, art teacher, Venus class children, PE teacher
March 04 09:00-09:40	Observer	Venus classroom	Class teacher, Venus class children, OLPC volunteer
March 04 10:15-11:50	Observer	Venus classroom	Class teacher, Venus class children, OLPC volunteer, EVS teacher
March 04 12:10-13:15	Observer	Venus classroom	Class teacher, Venus class children, Yoga teacher
March 04 13:15-13:30	Observer	Staff room	Social worker, class teacher
March 04 14:40-16:00	Observer	Venus classroom	Class teacher, Venus class children
March 05 09:00-11:40	Observer	Venus classroom, school corridor	Principal, class teacher, Venus class children, computer teacher
March 05 11:40-12:10	Observer	Virtual classroom	Computer teacher, Venus class children
March 05 14:20-15:00	Observer	Office of social worker and records room	Social worker

Date & Time	*Role*	*Location*	**Participants**
March 05 15:00-16:00	Observer	Venus classroom	Class teacher, Venus class children
March 06 09:00-13:00	Observer (only photo taking)	Venus classroom	Class teacher, Venus class children, OLPC volunteer, computer teacher, general volunteer
March 09 and March 10	No school (long holiday weekend)		
March 11 09:00-16:00	Observer	Venus classroom	Venus class children, music teacher, class teacher, EVS teacher
March 12 09:00-12:50	Observer	Venus classroom and music room	Music teacher, class teacher, Venus class children,
March 12 14:30-13:30	Observer	Venus classroom	Class teacher, Venus class children
March 13 09:30-12:10	Observer with participation	Venus classroom	Class teacher, Venus class children,
March 16 09:30-13:30	Observer	Venus classroom	Class teacher, Venus class children, OLPC volunteer,

Appendix C: Interview Guides

Semi-structured Interview Guide for Child Interviews

Phase 1: Demographic/Attitudinal

- What is your name?
- What is your age?
- Tell me about your family.
- Where do you stay?
- How do you come to school?
- Who are your friends in school?
- What are your Favourite subjects/things to do in school?
- Which subject are you good at/bad at?

Phase 2: Laptop Use and Preferences

- What do you like to do on the laptop?
- What do you not like to do on the laptop?
- Do you use the laptop alone or with friends? Why?
- Do you like to share the laptops? Why?
- Do you want to use the laptop more or less each week?
- Who do you ask if you have doubts with the laptop?
- Tell me what all you know about the laptop/know to do with it.
- Can you tell me about your favourite activities or lessons with the laptop?
- Have you told your family about the laptop? What? What did they say?

Phase 3: Computer literacy/attitudinal and behavioral

- Have you used a computer before the laptop? Where/how?
- Do you like computers? Why?
- What do you think computers are used for?
- Have you ever used Internet or know what it is? Email? Chat?
- Have your family used computer before?

Semi-structured Interview Guide for Computer Teacher (Interview 1)

- What is the first thing that comes to your mind when I say One Laptop Per Child? Why?

- Can you tell me about some working challenges you face with using the laptops?
- When did the use of OLPC laptops start at Yuva?
- So do the teachers get their own laptop?
- Can teachers take the laptops home to prepare for lessons?
- I heard you talking about the virtual classroom and the network and MCS to the visitors who were just here. Can you tell me a little about that?
- Can you tell me a little about your background and experience with computers?
- How do you like your work now as a computer teacher here at Yuva?
- When did you join Yuva?
- So were you here [at Yuva] before the OLPC laptops arrived? What do you remember about their introduction?
- Can you explain what the class names mean? I know they are named after planets but don't know the order.
- What kind of activities do you do with the other classes on the computer?
- Can you give me an example of a computer activity that you do with children?
- How do you plan what activities to do on a week-to-week basis? Are you given a syllabus?
- Do you create lesson activities yourself?

Semi-structured Interview Guide for Computer Teacher (Interview 2)

- What do you know about the learning philosophy the laptop is designed around?
- Does your school have a learning philosophy? Can you tell me about it?
- What similarities do you see between the ICSE syllabus and the learning philosophy of your school?
- What do you think is good about the way you use the laptop for lessons?
- What do you think is bad about the way you use the laptop for lessons?
- Who decided the laptop should be used for Maths and English only?
- Does the lesson or curriculum in any way constrain your use of the laptop?
- As a computer teacher, do you feel the laptop is used to its full potential? Why?
- Do you ever try anything creative/wild/fun just to see how it goes?
- Do you find that after the laptop came, the Venus class children interact differently with each other? How about the children in school in general?
- You mentioned you have an administrator. What kind of support does he provide? Is he a technical person? What is his involvement in each day or lesson?
- How much creative freedom do you feel you have when it comes to using the laptop?
- Do you think you need more training or support in any areas with the laptop?

What?

- Who do you think should provide the training for the laptop?
- Were you part of the training that was given to teachers? Can you tell me in detail what was covered?
- Has your relationship with students changed with the introduction of the laptop? How? Do you think this is a positive or negative change?
- Are there cases where a session is missed due to technical problems?
- Do you use any cultural expressions or vocabulary to make the laptop more familiar to learners?
- Do you find differences in the ways different children interact with the laptop?
- How do you think the childrens' background influences their use of the laptop?
- What skills do you think the children have developed by using the laptop?
- Do you think they will find it problematic to not use the laptop in Mars class (3rd standard)?
- Do you think OLPC is a good idea for children from this background?
- Could you share some memorable experiences from using the laptops with the kids?
- Can you share any frustrations you might have in connection with using the laptops?
- Do you think that the children can independently use the laptop, for example choose an application or create something you assign them?
- Are there aspects of the OS/software design that are easy or difficult? How about the neighbourhood feature - what do you think of that?
- Have you ever interacted with the family of the children? Have they said anything about the laptop?
- Next year, what will you cover for computers for the children (if you have the OLPC laptop for this class)? What is the next level (you mentioned step by step learning)?
- Do you have a planning or progress record or schedule for all activities done week to week on the laptop? A journal?
- Do you think this age group should have access to the Internet and chat? What class do you think they should start that?

Semi-structured Interview with OLPC Volunteer [and General Volunteer]

- What is the first thing you think of when you think of One Laptop Per Child?
- So are you saying that if each child had a laptop, things might be different?
- Do you see any other challenges with the use of the laptop? If so, what?
- Can you tell me a little about when the laptops came into Yuva?

- How has the laptop been used since then?
- How comfortable are the children with the laptop?
- What about Turtle Art? Do you use that in any activities?
- How often a week are the laptops used in class activities for the Venus class?
- So who handles all the logistics for the laptop and manages their use?
- How about the Internet or email? Are you able to use that in class activities and how?
- To summarize, what are some practical issues you face with the laptop?

Semi-structured Interview with OLPC Volunteer (Interview 2)

- As a volunteer, do you find any special challenges or lack of access to information related to the OLPC use in school?
- How many hours a week do you work with the Venus class? Doing what?
- How many hours do you spend preparing for each lesson for each day?
- What about science? Have you thought of using it there?
- Do you think you need more time to plan lessons?
- Do you feel you get enough lead time to design an activity?
- Have you ever made a wasted trip? Why?
- Any technical challenges you face in planning for a daily lesson?
- How similar or different is what they are doing here in Yuva different from the other school?
- Is [the other Bangalore school] similar to Yuva?
- Can you run me through what [Mr. John] did with the Turtle activity for you in terms of training?
- What kinds of activities do the children do with the regular computers?
- What about the neighbourhood or group and community feature? Is that used? Do you plan it in the future?
- Have you ever done anything wacky or wild with the laptop?

Semi-structured Interview with Class Teacher (Interview 1)

- When do the summer holidays start for the children?
- Do you often use the strategy of mixing up math concepts and testing?
- How do you prepare for classes? At home or at school?
- Do you teach any other classes apart from Venus class?
- Do you ever meet the teachers from the other branches and talk about your classrooms?

- What do you think about the OLPC laptop in your classroom?
- So do you think it is useful giving laptops to children?
- In your opinion, what percentage of the class do you think are slow learners?
- What is your typical teaching workload each week and how do you find it?
- What in your view are the benefits of the OLPC laptop for the children?
- Do you see any change in the use of the laptop since it was first started to be used?
- When the laptops first came, how did the children react?

Semi-structured Interview with Class Teacher (Interview 2)

- What do you know about the learning philosophy the laptop is designed around?
- Does your school have a learning philosophy? Can you tell me about it?
- What similarities do you see between the ICSE syllabus and the learning philosophy of the school?
- What do you think is good about the way you use the laptop for lessons?

Semi-structured Interview with Class Teacher (Interview 3)

- What do you think is bad about the way you use the laptop for lessons?
- Who decided that the laptop should be used for Math and English only?
- Does the lesson/curriculum in any way constrain your use of the laptop?
- Do you feel the laptop is used to its full potential? Why?
- Do you ever try anything creative/wild/fun just to see how it goes? What? When?
- Do you find that after the laptops arrived, the Venus class children interact differently with each other? How?
- How much creative freedom do you feel you have when it comes to using the laptop?
- Do you think you need more training/support in any areas with the laptop? What?
- Who do you think should provide the training?
- Were you a part of the training that was given to the teachers? Can you tell me in detail what all was covered?
- If you have doubts/technical questions, who do you reach out to? Are they able to help you?
- How has your relationship with students changed with the introduction of the laptop? Do you think this is a positive or negative change?
- Are there cases where a session is missed due to technical problems?
- Do you use any cultural expressions/vocabulary to make the laptop more familiar

to learners? Do they use any among themselves?

- Do you find differences in the ways different children interact with the laptop? What?
- How do you think the children's background influences the use of the laptop?
- What skills do you think the children have developed by using the laptop?
- Do you think they will find it problematic to not use the laptop when they move to the next class?
- Do you think OLPC is a good idea for children from this background?
- Could you share some memorable experiences from using the laptop with the kids?
- Can you share any frustrations you might have from using the laptop with the kids?
- Do you think that the children can independently use the laptop/choose an application?
- Are there aspects of the OS/software design that are easy/difficult? How about the group/community buttons?
- Have you ever interacted with the family of the children? Have they said anything about the laptop?

Depth Interview with CEO/Founder

- Can you tell me a little bit about yourself and the origins of Yuva?
- Could you elaborate on the idea of technology as a strategic fit some more.
- So you're saying that there was a technology philosophy before the OLPC laptop came in?
- Who provided the laptops?
- I heard that a one-day training session was provided by the OLPC team. Was this enough to get running with the laptop?
- You talked about the children learning about the world outside. Can you explain that some more.
- What about volunteers. Do they help you bring some of that outside world in?
- Does the moving nature of the volunteers provide any challenges?
- What do you think about the idea of low cost laptops? You might have heard about the many low cost laptops entering the market including India's plans of a 20$ laptop and 10$ laptop?
- What are some the biggest challenges for you as the CEO and as the management?
- Would you say that is your key differentiator?
- Can you tell me more about the Community Development Services program? What kind of benefits are you seeing to that?

- You talked about the problems in government schools in India and the Yuva presentation talked about overcoming the hurdles common in those schools. What are the key differences between Yuva and such schools?
- Are you happy with your decision to start Yuva?

Semi-structured Interview with Principal

- Why do the children call everyone "akka" but refer to you as "mummy"?
- How long have you been with Yuva?
- Can you tell me a little bit about your experience as the principal at Yuva.
- How does Community Development Services (CDS) help you cope with these issues?
- I notice you are a very hands-on principal. Is there a reason for this?
- Can you tell me a little about your background?
- When did you join Yuva?
- Can you tell me a little bit about your experience with Yuva since the time you joined?
- Can you tell me about the arrival of the OLPC laptops in the school from what you remember?
- Overall, what are your thoughts about the OLPC laptop in terms of learning for the Venus class?
- What are the top challenges in your opinion when it comes to the OLPC laptop.
- What do you do when issues come up with the laptops?

Semi-structured Interview with EVS Subject Teacher

- What is the first thing you think about when you think of the XO laptop? Why?
- What do you think/know about the learning philosophy the laptop is designed around?
- Does your school have a learning philosophy? Can you tell me a little about this?
- What kinds of similarities do you see between the ICSE syllabus and the learning philosophy of your school? What differences?
- What kinds of harmonies do you see between the curriculum and the use of the laptop?
- What kinds of issues do you see between the curriculum and day-to-day activities with the laptop?
- Is there a reason the laptops are not used for EVS?
- Do you find that the introduction of the laptop has influenced the way the children interact with each other? How?

- Have you ever noticed quarrels about the laptop? If so, what?
- How much training did you receive before you started to teach with the laptop? Who provided this training?
- Do you find differences in the ways different children interact with the laptop? What kinds of differences?
- How do you think the student demographic and background sociocultural experiences influence their use of the laptop?
- Do you think a single laptop per child is a good idea for socially-disadvantaged children? Why?
- Do you think a single laptop per child is good for children in general? Why?

Unstructured Interview with Social Worker

- Can you tell me a little about your role and duties at Yuva?
- How do you know if there are any problems with a child or family?
- In what other ways do you take care of children or families?
- How do you select students for Yuva?
- How aware are children about the idea of domestic violence or that they are from a vulnerable population?
- Is the application process then only by purposefully selecting families/children?
- Can we go over the steps in order so I have it correct?
- What else does CDS handle apart from admissions and family programs?
- Can you tell me a little about the slums the children come from? Are they similar?

REFERENCE LIST

Akpan, P. I. (2005). Basic-needs to globalization: Are ICT the missing link? *Information Technology for Development, 10* (4), 261-274.

Allen, D. W. (2003). The effects of technology on educational theory and practice: A 20-year perspective. In D. L. Johnson & C. D. Maddux (Eds.), *Technology in education: A twenty-year retrospective*. USA: The Haworth Press, Inc.

Anderson, R. E., & Ronnkvist, A. (1998). *The presence of computers in American schools. Teaching, learning, and computing: 1998 national survey*. Center for Research on Information Technology and Organizations, Report #2 (ERIC Document Reproduction Service No. ED430548).

Armstrong, A., & Casement, C. (2000). *The child and the machine: How computers put our children's education at risk*. Beltsville, MD: Robins Lane Press.

Aronson, J. (1994). A pragmatic view of thematic analysis. *The Qualitative Report, 2* (1). Retrieved on July 01, 2009 from http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html.

Auerbach, C., & Silverstein, L. B. (2003). *Qualitative Data: An introduction to Coding and Analysis*. New York University Press: New York.

Aviram, A., & Eshet-Alkalai, Y. (2006). Towards a theory of digital literacy: Three scenarios for the next steps. *European Journal of Open, Distance and E-Learning*. Retrieved on July 01, 2009 from http://www.eurodl.org/materials/contrib/2006/Aharon_Aviram.htm.

Baliamoune-Lutz, M. (2003). An analysis of the determinants and effects of ICT diffusion in developing countries. *Information Technology for Development, 10*, 151-169.

Banerjee, A., Cole, S., Duflo, E., & Linden, L. (2007). Remedying education: Evidence from two randomized experiments in India. *The Quarterly Journal of Economics, 122* (3), 1235-1264.

Barja, G., & Sören-Gigler, B. (2007). The concept of information poverty and how to measure it in the Latin American context. In H. Galperin & J. Mariscal (Eds.), *Digital poverty: Latin American and Caribbean perspectives* (pp. 11-28). Practical Action Publishing/IDRC.

Barrantes, R. (2007). Analysis of ICT demand: What is digital poverty and how to measure it? In H. Galperin & J. Mariscal (Eds.), *Digital poverty: Latin American and Caribbean perspectives* (pp. 29-53). Practical Action Publishing/IDRC.

Becker, H.J. (2000a). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Contemporary Issues in Technology and Teacher Education*, *1*(2), 274-293.

Becker, H. J. (2000b). Who's wired and who's not: Children's access to and use of computer technology. *Children and Computer Technology, The Future of Children, 10*(2), 44-75.

Becker, J. (1998). Running to catch a moving train: Schools and information technologies. *Theory into Practice*, *37*(1), 20-30.

Benjamin, S. (2000). Governance, economic settings and poverty in Bangalore. *Environment and Urbanisation, 12*(1), 35-56.

Bentley, C. (2007). The OLPC laptop: Educational revolution or devolution?. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2007* (pp. 647-652). Chesapeake, VA: AACE.

Bielefeldt, T. (2006). Teaching, learning, and one-to-one computing. Background paper for *Ubiquitous Computing: Near Future and Far Horizons*. Panel discussion, NECC 2006. San Diego, July 2006.

Bitzer, D. (1976). The Wide World of Computer-Based Education. In M. Rubinoff, & M. C. Yovits (Eds.), Advances in Computers, Vol. 15, pp. 239-283. New York: Academic Press.

Boston Indicators Project (2006). Ratio of students per computer: Boston public schools. Boston, MA: The Boston Foundation. Retrieved on May 04, 2009 from http://www.bostonindicators.org/IndicatorsProject/Technology/Indicator.aspx?id=3012.

Brady, M. (2000). The digital divide myth. Ecommerce Times: Commerce. August 04, 2000. Retrieved on January 10, 2009 from http://shulman.ucsur.pitt.edu/doc/Supplemental/DigitalDivide/DigitalDivideMyth.pdf.

Buchele, S. F., & Owusu-Aning, R. (2007). The One Laptop Per Child (OLPC) project and its applicability to Ghana. In *Proceedings of the 2007 International Conference on Adaptive Science and Technology, December 2007*, pp. 113-118. Retrieved on March 05, 2009 from http://people.southwestern.edu/~bucheles/ICAST_OLPC_Paper.pdf.

Burton, L. (1999). The implications of a narrative approach to the learning of mathematics. In L. Burton (Ed.), *Learning mathematics: From hierarchies to networks* (pp. 21-35). London: Falmer Press.

Caelli, K., Ray, L., & Mill, J. (2003). Clear as mud: Toward greater clarity in generic qualitative research. *International Journal of Qualitative Research Methods, 2*(2), 1-23.

Chandrasekhar, C. P., & Ghosh, J. (2001). Information and communication technologies and health in low income countries: The potential and the constraints. *Bulletin of the World Health Organization, 79* (9). Retrieved on June 01, 2009 from http://www.scielosp.org/scielo.php?pid=S0042-96862001000900010&script=sci_arttext&tlng=en.

Chishti, S. (2006, July 24). HRD rules out laptops for kids, says can result in 'disembodied brains'. *Indian Express*. Retrieved on July 01, 2009 from http://www.indianexpress.com/news/hrd-rules-out-laptops-for-kids-says-can-res/9192/.

Collis, B. A., & Sakamoto, T. (1996). Children in the information age. In S. A. Collis et al. (Eds.), *Children and Computers in Schools*. Mahwah, NJ: Lawrence Erlbaum Associates.

Comaroff, J. (1992). *Ethnography and the historical imagination*. Boulder, CO: Westview Press.

Compaine, B. M. (ed.) (*2001). The digital divide: Facing a crisis or creating a myth?.* Cambridge, MA: The MIT Press.

Computer Aid International (2009). Report on low-power PC research project. Retrieved from http://www.computeraid.org/pdffiles/Report%20on%20Low-Power%20PC%20Research%20Project%20April%202009.pdf.

Corbin, J. M., & Strauss, A. L. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. United Kingdom: SAGE Publications.

Crabtree, B. F., & Miller, W. L. (1999). *Doing Qualitative Research (2nd Edition).* Thousand Oaks, CA: SAGE Publications.

Crabtree, B. F., Miller, W. L., & Stange, K. C. (2001). Understanding practice from the ground up. *The Journal of Family Practice, 50*(10), 881-887.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Prentice Hall.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Cuban, L. (1993). Computers meet classroom: Classroom wins. *Teachers College Record, 95*(2), 185-210.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

Cuban, L., Kirkpatrick, H., & Peck, C. (2003). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Cullen, R. (2001). Addressing the digital divide. *Online Information Review, 25*(5), 311-320.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26* (3&4), 325-346.

Denzin, N. K. (1970). *The research act in sociology.* Chicago: Aldine.

Doering, A., Hughes, J., & Huffman, D. (2003). Preservice teachers: Are we thinking with technology. *Journal of Research on Technology in Education, 35*(3), 342-362.

Dooley, K. E. (1999). Towards a holistic model for the diffusion of educational technologies: An integrative review of educational innovation studies. *Educational Technology & Society 2*(4), 35-45.

Doyle, W. (1990). Classroom knowledge as a foundation of teaching. *Teachers College Record*, *91* (3), 347-360.

Draca, M., Sadun, R., & Van Reenen, J. (2007) .ICT and productivity. In R. Mansell, C. Avgerou, D. Quah, and R. Silverstone (Eds.), *Oxford Handbook of Information of Information and Communication Technologies*. Oxford: Oxford University Press.

Dunleavy, M., Dexter, S., & Heinecke, W. F. (2006). What Added Value Does a 1:1 Student to Laptop Ratio Bring To Technology-Supported Teaching And Learning? Ubiquitous Computing Implementation Research Technical Report #7, University of Virginia, Charlottesville, VA. Retrieved on June 20, 2009 from http://edtechcases.info/analysis/classroom_uses.htm.

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1994). The evolution of teachers' instructional beliefs and practices in high-access-to-technology classrooms: First-fourth year findings. Apple Classrooms of Tomorrow (ACOT) Report #8. Cupertino, CA: Apple Computer Inc.

Dwyer, S. C., & Buckle, J. L. (2009). The space between: On being an insider-outsider in qualitative research. *International Journal of Qualitative Methods, 8* (1), 54-63.

Egbert, J., Paulus, T. M., & Nakamichi, Y. (2002). The impact of call instruction on classroom computer use: A foundation for rethinking technology in teacher education. *Language Learning & Technology, 6* (3), 108-126.

Emerson, R., Fretz, R., & Shaw, L. (1995). *Writing ethnographic fieldnotes*. Chicago: University of Chicago Press

Eshet-Alkalai, Y. (2004). Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia, 13*(1), 93-106.

Gaudin, S. (2008). HP unveils low-cost mini-laptop for education market. April 8, 2008. Retrieved on April 05, 2009 from http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9075739.

Gaver, W. W. (1991). Technology affordances. Proceedings of the CHI '91 Conference on Computer and Human Interaction. 1991, March. New York: ACM Press.

Geertz, C. (1993). *The interpretation of cultures*. New York: Basic Books.

Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social Problems, 12*, 436-445.

Glaser, B. G., & Strauss, A. L. (1977). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Glewwe, P., & Kremer, M. (2006). Schools, teachers, and education outcomes in developing countries. In E. Hanushek & F. Welch (Eds.), *Handbook of the Economics of Education*. London: North-Holland.

Grace, J., & Kenny, C. (2003). A short review of information and communication technologies and basic education in LDCs—what is useful, what is sustainable? *International Journal of Educational Development, 23*(6), 627-636.

Grimes, D., & Warschauer, M. (in press). Learning with laptops: A multi-method case study. Journal of Educational Computing Research.

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Technology Research and Development, 29* (2), 75-91.

Hawkins, R. J. (2002). Ten lessons for ICT and education in the developing world. In *The Global Information Technology Report 2001-2002: Readiness for the Networked World (chap. 4)*. Oxford: Oxford University Press. Retrieved from http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN008676.pdf.

Hawkridge, D. (1996). Who needs computers in schools, and why? In D. P. Ely & T. J. Plomp (Eds.), *Classic Writings on Instructional Technology*. Englewood, CO: Libraries Unlimited.

Hepp, P. K., Hinostroza, E. S., Laval, E. M., & Rehbein, L. F. (2004). Technology in schools: Education, ICT and the knowledge society. Washington: The World Bank. Retrieved on July 01, 2009 from http://siteresources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099079947580/ICT_report_oct04a.pdf.

Hokanson, B., & Hooper, S. (2000). Computers as cognitive media: examining the potential of computers in education. *Computers in Human Behavior, 16*, 537-552.

Human Resources and Skills Development Canada (2005). Indicators of well-being in Canada: Learning – computer access in schools. Retrieved from http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=28.

Hurn, C. J. (1993). The limits and possibilities of schooling (3rd edition), chapter 4. Boston: Allyn & Bacon.

Introna, L. (2007). Making sense of ICT, new media and ethics. In R. Mansell, C. Avgerou, D. Quah, & R. Silverstone (Eds.), *The Oxford Handbook of Information and Communication Technologies*. Oxford: Oxford University Press.

iWatch (2008). Wake up call for India: Good governance. Retrieved on May 01, 2009 from http://www.wakeupcall.org/administration_in_india/poverty_line.php.

Jacob, C. (2008, July 17). One crore to make Bangalore home by 2012. *SiliconIndia*. Retrieved on August 01, 2009 from http://www.siliconindia.com/shownews/One_crore_to_make_Bangalore_home_by_2012-nid-43727.html.

James, J. (2002). Low-cost information technology in developing countries: current opportunities and emerging possibilities. *Habitat International, 26* (1), 21-31.

Jenson, J., de Castell, S., & Bryson, M. (2003). "Girl talk": gender, equity, and identity discourses in a school-based computer culture. *Women's Studies International Forum, 26*(6), 561-573.

Johnson, D. L. (2003). The dream machine. In D. L. Johnson & C. D. Maddux (Eds.), *Technology in education: A twenty-year retrospective*. USA: The Haworth Press, Inc.

Johnstone, B. (2003). Never mind the laptops: Kids, computers, and the transformation of learning. Lincoln, NE: iUniverse Publishers.

Jonassen, D. (1996). Computers in the classroom: Mindtools for critical thinking. Englewood Cliffs, NJ: Prentice Hall.

Katz, J. E., & Rice, R. E. (2002). Social consequences of internet use: Access, involvement, and interaction. Cambridge, MA: The MIT Press.

Kay, A. C. (1972). A personal computer for children of all ages. In Proceedings of the ACM National Conference (pp. 1-11). New York: ACM Press.

Kearns, P. (2002) Towards the connected learning society. *An International Overview of Trends in Policy for Information and Communication Technology in Education*. Global Learning Services, Australia, June.

Kling, R. (1980). Social analyses of computing: Theoretical perspectives in recent empirical research. *Computing Surveys, 12*(1), 61-110.

Klotz, A. (2008). Case selection. In A. Klotz & D. Prakash (Eds.), *Qualitative Methods in International Relations: A Pluralist Guide*. Basingstoke, Hampshire: Palgrave Macmillan.

Kozma, R., McGhee, R., Quellmalz, E., & Zalles, D. (2004). Closing the digital divide: Evaluation of the World Links program. *International Journal of Educational Development, 24*(4), 361-381.

Kozma, R. (2007). One Laptop Per Child and educational reform. OLPC News, June 22, 2007. Retrieved on January 10, 2009 from http://www.olpcnews.com/use_cases/education/one_laptop_per_child_education.html.

Kozma, R. B. (2006). Toward an African knowledge network: ICT in support of grassroots rural development. Keynote address, ICTe Africa 2006, NEPAD Council. May 18, 2006, Nairobi, Kenya.

Kozma, R. B. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology 1*(2), 117-156.

Kraemer, K., Dedrick, J., & Sharma, P. (2009). One Laptop Per Child (OLPC): Vision vs. reality. *Communications of the ACM*, *52*(6), 66-73.

Lankshear, C. (2003). The challenge of digital epistemologies. Education, *Communication and Information, 3* (2), 167-186.

Lankshear, C., & Knobel, M. (2003). *New literacies: Changing knowledge and classroom learning*. Buckingham, UK: Open University Press.

Lankshear, C., Snyder, I., & Green, B. (2000). *Teachers and technoliteracy: Managing literacy, technology and learning in schools*. St. Leonards, Australia: Allen & Unwin.

Laurillard, D. (1987). Computers and the emancipation of students: giving control to the learner. *Instructional Science, 16* (1), 1573-1952.

Lei, J., Conway, P. F., & Zhao, Y. (2008). *The digital pencil: One-to-one computing for children*. New York: Lawrence Erlbaum Associates.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic Inquiry. Beverly Hills, CA: SAGE Publications.

Lopez-Bassols, V. (2002). ICT skills and employment. Paris: OECD. Retrieved on June 10, 2009 from http://ideas.repec.org/p/oec/stiaaa/2002-10-en.html.

Loughran, J. J. (2002). Effective reflective practice: In search of meaning in learning about teaching. *Journal of Teacher Education, 53* (1), 33-43.

Löwgren, J., & Stolterman, E. (2004). *Thoughtful interaction design: A design perspective on information technology*. Cambridge, MA: The MIT Press.

McNamara, K.S. (2003). Information and communication technologies, poverty and development: Learning from experience. A Background paper for the InfoDev Annual Symposium. Washington, D.C.: The World Bank.

Mabry, L. (2008). Case study in social research. In P. Alasuutari, L .Bickman, & J. Brannen (Eds.), *The SAGE Handbook of Social Research Methods*. London, UK: SAGE Publications.

Maldonado, E., Pogrebnyakov, N. and Van Gorp, A. (2006). ICT policies as a means to inhibit social exclusion: The South African case. In D. Howcroft, E. Trauth, &J. I. DeGross (Eds.), *Social Exclusion: Societal and Organizational Implications for Information Systems*, pp. 137-150. New York, NY: Springer.

Martinez, M. E. (1999). Access to information technologies among school-age children: Implications for a democratic society. *Journal of the American Society for Information Science and Technology, 45* (6), 395-400.

Mathison, S. (1988). Why triangulate? *Educational Researcher, 17* (2), pp. 13-17.

Miller, W. L., & Crabtree, B. F. (2004). Depth interviewing. In S. N. Hesse-Baber & P. Leavy (Eds.), *Approaches to qualitative research: A reader on theory and practice*. Oxford: Oxford University Press.

Morales-Gómez, D., & Melesse, M. (1998). Utilising information and communication technologies for development: the social dimensions. *Information Technology for Development, 8*(1), 3-13.

Nordkvelle, Y., & Olson, J. (2005). Visions for ICT, ethics and the practice of teachers. *Education and Information Technologies, 10* (1-2), 21-32.

Norman, D.A. (1993). *Things that make us smart: Defending human attributes in the age of the machine*. Reading, MA: Addison-Wesley Publishing Co.

Norris, P. (2001). *Digital divide: Civic engagement, information poverty, and the Internet worldwide*. Cambridge, New York: Cambridge University Press.

Novak, T. P., & Hoffman, D. L. (1998). Bridging the digital divide: The impact of race on computer access and Internet use. Washington DC: Vanderbilt University. Retrieved on July 01, 2009 from http://www.cybercultura.it/pdf/1998_Bridging_Digita_Divide.pdf.

Nystedt, D. (2008). Acer Netbook shipments to beat Asus's Eee PC. IDG News Service. October 31, 2008. Retrieved on February 08, 2009 from http://www.pcworld.com/businesscenter/article/153114/acer_netbook_shipments_to_beat_asuss_eee_pc.html.

OLPC India (n.d.). Retrieved from the OLPC Wiki: http://wiki.laptop.org/go/OLPC_India.

Oostveen, A-M. (2007). Context matters: A social informatics perspective on the design and implications of large-scale e-government systems. Doctoral dissertation, University of Amsterdam. Retrieved on March 25, 2009 from http://www.social-informatics.net/PROEFSCHRIFT%20OOSTVEEN.pdf.

Oppenheimer, T. (July 1997). The computer delusion. The Atlantic Monthly. Retrieved on April 15, 2009 from http://innovations.oise.utoronto.ca/~jhewitt/ctl1602/papers/Oppenheimer%201997.pdf.

Osin, L. (1998). Computers in education in developing countries: Why and how? The *Education and Technology Series, 3(1), World Bank Human Development Department Education Group*.

Panagariya, A. (2008). *India: The emerging giant*. Oxford: Oxford University Press.

Papert, S. (1987). Computer criticism vs. technocentric thinking. *Educational Researcher, 16* (1), 22-30.

Papert, S. (1992). *The children's machine: Rethinking school in the age of the computer*. New York: Basic Books.

Papert, S. (1993). *Mindstorms: Children, computers and powerful ideas (Second edition)*. New York: Basic Books.

Patra, R., Pal, J., Nedevschi, S., Plauche, M., & Pawar, U. S. (2007). Usage models of classroom computing in developing regions. In Proceedings of International Conference on Information Technologies and Development (ICTD2007), IEEE Computer Society, pp. 158-167, Bangalore, India.

Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research, 34* (5 Pt 2), 1189-1208.

Pawar, U., Pal, J., & Tomaya, K. (2006). Multiple mice for computers in education in developing countries. Paper presented at the International Conference on Information and Communication Technologies and Development, 2006. ICTD '06, pp. 64-71. Retrieved on June 05, 2009 from http://research.microsoft.com/en-us/um/india/groups/tem/presentations/Multimouse_ICTD_2006.pdf.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: results from a worldwide educational assessment. *Computers & Education, 37*, 163-178.

Penuel, W. R. (2006). Implementation and effects of 1:1 computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329-348.

Pilat, D., & Wolfl, A. (2004). ICT production and ICT use: What role in aggregate productivity growth? In *The Economic Impact of ICT: Measurement, Evidence and Implications*. Paris: OECD Publishing.

Pilat, D. (2004). The ICT productivity paradox: Insights from micro data. *OECD Economic Studies, 38* (1).

Poeter, D. (2008). Look out OLPC, Intel's new Classmate is a tablet. August 20, 2008. ChannelWeb. Retrieved on February 05, 2009 from http://www.crn.com/white-box/210102176.

Prasad, S. (2008). Indian schools spur virtual PC demand. ZDNet Asia News: Hardware, July 22, 2008. Retrieved on May 30, 2009 from http://www.zdnetasia.com/news/hardware/0,39042972,62044023,00.htm.

Rangaswamy, N., & Toyama, K. (2005). Sociology of ICT: The myth of the hibernating village. Bangalore, India: Microsoft Research India. Retrieved from http://research.microsoft.com/users/nimmir/HCII2005%20Rangaswamy.doc

Resnick, M. (2002). Rethinking learning in the digital age. In G. Kirkman (Ed.), *The global information technology report: Readiness for the networked world*, pp. 32-37. Oxford: Oxford University Press.

Rieber, L. P., & Hannafin, M. J. (1988). Effects of textual and animated orienting activities and practice on learning from computer-based instruction. *Computers in the Schools, 5* (1&2), 77-90.

Rogers, E. *(*1995*). Diffusion of innovations*. New York: Free Press.

Rooksby, E. & Weckert, J. (2004) Digital divides: Their social and ethical implications. In Brennan, L. & Johnson, V. (Eds.), *Social, Ethical and Policy Implications of Information Technology* (pp. 29-47). Hershey, PA, USA: Information Science Publishing.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *Children and Computer Technology, 10*(2), 76-101.

Roschelle, J., Penuel, W. R., & Abrahamson, A. L. (2004). The networked classroom. *Educational Leadership, 61*(5), 50–54.

Rosenberg, M. J. (2000). *E-learning: Strategies for delivering knowledge in the digital age*. New York: McGraw-Hill.

Ross, S. M., Lowther, D. L., Wilson-Relyea, B., & Wang, W. (2003). Anytime, Anywhere Learning: Final evaluation report of the laptop program: Year 3. Memphis, TN: University of Memphis. Retrieved May 05, 2009 from http://www.nteq.com/Research/Year1.pdf.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research*, *30*, 313-330.

Salomon, G. and Perkins, D. (1996) Learning in wonderland: What do computers really offer education? In S. T. Kerr (ed.), *Technology and the Future of Schooling*, pp. 111-130. Chicago, IL: University of Chicago Press.

Sassen, S. (2004). Towards a sociology of information technology. In C. Avgerou, C. Ciborra, & F. Land (Eds), *The Social Study of Information and Communication Technology,* pp. 77-99. Oxford: Oxford University Press.

Schifter, C. C. (2008). Infusing technology into the classroom: Continuous practice improvement. Hershey, NY: Information Science Publishing.

Schön, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. San Francisco, CA, US: Jossey-Bass.

Schuldman, M. (2004). Superintendent conceptions of institutional conditions that impact teacher technology integration. *Journal of Research on Technology in Education, 36* (4), 319-343.

Seale, C. (2008). Using computers to analyze qualitative data. In *Doing qualitative research: A comprehensive guide* (D. Silverman & A. Marvasti), pp. 233-256. Los Angeles: SAGE Publications.

Seidman, I. (1998). Technique isn't everything, but it is a lot. In Interviewing as Qualitative Research, pp. 63-78. New York, NY: Teachers College Press.

Selwyn, N. (2004). Reconsidering political and popular understandings of the digital divide. *New Media & Society, 6* (3), 341-362.

Sen, A. K. (1999). *Development as freedom*. Oxford: Oxford University Press.

Servon, L. (2002) *Bridging the digital divide: Technology, community and public policy* (pp. 8, 33-34). Melbourne: Blackwell Publishing.

Shah, A. (2007, December 20). OLPC struggles to realize ambitious vision. *PC World*. Retrieved on July 02, 2009 from http://www.pcworld.com/article/140698/olpc_struggles_to_realize_ambitious_vision.html.

Sherman, R. R., & Webb, R. B. (1988). Qualitative research in education: A Focus. In R. R. Sherman & R. B. Webb (Eds.), Qualitative research in education: Focus and Methods. New York: Falmer Press.

Silverman, D., & Marvasti, A. (2008). Doing qualitative research: A comprehensive guide. Thousand Oaks, California: SAGE Publications.

Silvernail, D., & Lane, D. M. M. (2004). *The impact of Maine's one-to-one laptop program on middle school teachers and students: Phase one summary evidence*. Portland, ME: Maine Education Policy Research Institute, University of Southern Maine.

Skinner, B. F. (1958). Teaching machines. Reprint from Science, October 24, 1958, Vol 158, No. 3330, pp. 969-977. Retrieved on April 25, 2009 from http://www.bfskinner.macwebsitebuilder.com/f/teaching_machines.pdf.

Smith, M. R., & Marx, L. (2001). Does technology drive history? The dilemma of technological determinism. Cambridge, MA: MIT Press.

Snyder, I. (ed.) (2002). Silicon literacies: Communication, innovation, and education in the electronic age. London: Routledge.

Stake, R. E. (1978). The case study method in social inquiry. *Educational Researcher, 7*(2), 5-8.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: SAGE.

Steinmueller, W. E. (1999). ICT and the possibilities for leapfrogging by developing countries. *International Labour Review, 140*(2), 193-210.

Stoll, C. (1996). Silicon snake oil: Second thoughts on the information highway. New York: Anchor Books.

Sutton, R. (1991). Equity and computers in the schools: A decade of research. *Review of Educational Research, 61*(4), 475-503.

Tiene, D. (2002). Addressing the global digital divide and its impact on educational opportunity. *Educational Media International 39*(3&4), 212-222.

Tilak, J. B. G. (2006). Education: A saga of spectacular achievements and conspicuous failures. In *India Social Development Report*. Oxford University Press, Council for Social Development, New Delhi.

Triggs, P., & Sutherland, R. (2009). A holistic approach to understanding teaching and learning with ICT. In R. Sutherland, S. Robertson, & P. John (Eds.), *Improving classroom learning with ICT* (pp. 3-26). New York: Routledge.

United Nations Development Program (1999). *Human development report*. New York: Oxford University Press.

van 't Hooft, M., Swan, K., Cook, D., & Lin, Y. (2006). What is ubiquitous computing? In M. van 't Hooft & K. Swan (Eds.). *Ubiquitous computing in education: Invisible technology, visible impact*. (pp. 3-17) Lawrence Erlbaum Associates.

van Manen, M. (1990). Researching lived experience: Human science for an action sensitive pedagogy. London, Ontario: SUNY.

Warren, M F (2002). Digital divides and the adoption of information and communication technologies in the UK farm sector. *International Journal of Information Technology and Management 1* (4), 385-405.

Warren, M. (2007). The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommunications Policy, 31*, 374-388.

Warschauer, M. (2003). Dissecting the "digital divide": A case study in Egypt. *The Information Society, 19,* 297-304.

Warschauer, M. (2006). *Laptops and literacy: Learning in the wireless classroom*. New York and London: Teachers College Press.

Warschauer, M. (2007). The paradoxical future of digital learning. *Learning Inquiry, 1*(1), 41-49.

Warschauer, M., Knobel. M., & Stone, L. (2004). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy, 18* (4), 562-588.

Wiburg, K. M. (2003). Technology and the new meaning of educational equity. In D. L. Johnson & C. D. Maddux (Eds.), Technology in education: A twenty-year retrospective. USA: The Haworth Press, Inc.

Willis, J. (2003). Instructional technologies in schools: Are we there yet? In D. L. Johnson & C. D. Maddux (Eds.), Technology in education: A twenty-year retrospective. USA: The Haworth Press, Inc.

Willis, J., Jost, M., & Nilakanta, R. (2008). Qualitative research methods for education and instructional technology. Charlotte, NC: Information Age Publishing.

Wilson, G., & Stacey, E. (2004). Online interaction impacts on learning: Teaching the teachers to teach online. *Australasian Journal of Educational Technology, 20 (1), 33-48.*

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal 39* (1), 165-205.

Wolcott, H. F. (2008). *Writing up qualitative research*. Thousand Oaks, CA: SAGE.

Zee News (2006). HRD ministry rejects plan panel's idea of laptop per child. Zee News India Edition: Home, Nation. July 24, 2006. Retrieved on June 01, 2009 from http://www.zeenews.com/news311216.html.

Zucker, A. A., & McGhee, R. (2005). A study of one-to-one computer use in mathematics and science instruction at the secondary level in Henrico County public schools. Arlington, VA: SRI International.