THE BANGALORE CHALLENGE:
CASE STUDIES OF THE SOCIAL CONSTRUCTION OF TECHNOLOGY IN ELEMENTARY SCHOOLS

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ABSTRACT

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As India aspires to become the information and communication technology (ICT) leader in the world, the education of its children is a primary concern. While India's policymakers expect ICT to usher in promising education changes, there is a limited understanding of how computers are used and negotiated in India's schools. This dissertation is an ethnographic study of the meanings and uses for computer technology in elementary schools settings in Bangalore, India. The dissertation's purpose is to describe and report on how computer technology is socially constructed in Bangalore's fifth grade classrooms. Using case study research design, the dissertation investigates and compares the social shaping of computer technology in a socioeconomic cross-section of four elementary schools.

The dissertation's research questions and methodological approach are framed by the Social Construction of Technology (SCOT) theory. SCOT maintains that social groups, like students and teachers, construct the meanings and purposes for technology based on their social context and interactions. In schools, the social shaping of technology happens in a context of use and negotiation among students and teachers. The dissertation's data are comprised of field notes from extensive field observations, student and teacher questionnaires, teacher interviews, student focus group interviews, and artifacts, like digital pictures, of each elementary school setting.

How computer technology is socially constructed in Bangalore's elementary schools is a complex phenomenon. The dissertation thickly describes and offers various interpretations to clarify this complexity. This study illustrates how students and teachers assign meanings to computer technology in relationship to the school's curriculum and pedagogical practices. The dissertation also examines how the diverse meanings for computer technology relate to contextual factors like the school's mission statement and the predominant socio-economic status (SES) of the student body.

At the dissertation's two lower SES schools, both of which were located in villages, the students used the school's computer technology primarily to practice and learn English. Both school's teachers and students interpreted that computer technology was empowering and provided the opportunity for a better life. At the dissertation's middle SES school, the students used the school's computer technology as part of a scripted computer science curriculum based on coding skills. Additionally, the computer science teachers at this school stated that the computer's primary purpose was for the development of logic skills needed for programming and engineering software. At the dissertation's upper SES school, the students used the school's computer technology to develop their research and presentation skills. At this school, the teachers and students agreed that the computer's most important purpose was to foster original thinking and the ownership of ideas.

The dissertation concludes that accessory social groups, like non-governmental organizations and the school administrators, have significant influence in stabilizing the meanings assigned to technology. The dissertation's findings enhance the understandings of the way that social groups, in Bangalore's elementary schools, use and assign meaning to computer technology.

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For most of my life I have been charmed by India. India's rhythm and spice are a celebration of life. I am fascinated with India's transparency; its guile, squalor, and milking cows are found on most every corner. Yet, in most corners of India, opportunity is also there. Or perhaps it is more accurate to say that opportunity is, at least, advertised. These advertisements often are in the form of billboards and posters promoting education, namely: English tutoring and computer classes. During my first visit to Bangalore, I marveled at the plethora of education and technology advertisements that dotted street corners and telephone poles. The advertisements piqued my curiosity and professional aspiration to research the intersection of education and technology as represented in Bangalore. This dissertation is a goal fulfilled and I have so many people to thank for making it possible.

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KEY TO ABBREVIATIONS

ASER..... Annual Status of Education Report

CAL ..... Computer Assisted Learning

CBSE..... Central Board of Secondary Education

EFA..... Education for All

FOSS ..... Free and Open Source Software

IB ..... International Baccalaureate

ICSE..... Council for Indian School Certificate Examination

ICT ..... Information and Communication Technology

MDGs ..... Millennium Development Goals

NCERT ..... National Council for Educational Research and Training

NGO ..... Non-governmental Organization

PPP ..... Public Private Partnerships

RTE ..... Right of Children to Free and Compulsory Education Act

SC .....Scheduled Caste

SCOT ..... Social Construction of Technology

SSA ..... Sarva Shiksha Abhiyan

SSBE..... State Board of Education Syllabus

TPACK ..... Technological, Pedagogical, and Content Knowledge

UEE ..... Universalization of Elementary Education

UNESCO ..... United Nations Education, Scientific, and Cultural Organization

CHAPTER 1

INTRODUCTION

"THE BANGALORE CHALLENGE"

In his September 2010 "back to school" speech, President Obama urged students in the United States to work harder in order to keep pace with students in Bangalore, India. He stated, "At a time when countries are competing with us like never before, when students in Bangalore, India, are working harder than ever . . . success in school is going to determine success in the twenty-first century" ("Working Harder," 2010). This speech, now nicknamed in India as the "Bangalore Challenge," highlighted a perceived competitive edge that Indian students, especially in metropolises like Bangalore, have in areas like math, science, and technology. According to President Obama, success in this century will be determined by how students respond to the Bangalore Challenge.

This dissertation examines a facet of the Bangalore Challenge by investigating how and why elementary students in Bangalore use computer technology. I examine these "how" and "why" questions within the context of India's elementary school system, which is the level of schooling that is attended by more of India's vast population than any other (Ramachandran & Sharma, 2009). Using case study research design based in an ethnographic tradition, I investigate and compare the uses for computer technology in a socioeconomic cross-section of four of Bangalore's elementary schools. Specifically, I focus on how each school's fifth grade students and their teachers construct and negotiate meaning for computer technology use. I seek to better understand how the social-cultural context and participants' backgrounds inform the meanings that participants assign to computer technology. The dissertation's research questions and methodological approach are framed by the Social Construction of Technology theory,

which is a social constructivist theory for examining how social actors shape and give meaning to technology based, in part, on their socio-cultural context.

Statement of the Problem

To investigate the dissertation's problem, I start by examining Bangalore as both a place and an idea. Bangalore shares the dual and somewhat binary nicknames of "India's Silicon Valley" and "India's Garden City." In early Indian history, Bangalore was known as a lush retreat for South Indian royals. Today, Bangalore is a place that echoes with the hum of computer technology and the din of globalization. Bangalore as the nexus of globalization was popularized by the writings of Thomas Friedman, author of *The World is Flat.* Friedman (2005) asserts that Bangalore "represents the possibility to collaborate and compete in real time with other people on more different kinds of work from more different corners of the planet on a more equal footing than at any previous time in history" (p. 8). Indeed, many developed nations' industries rely on the Indian workforce and India's reach as technological leader touches most developed nations. Thus, Bangalore represents the possibilities of Indian society.

Yet, the realities of Indian society show that India's technological leadership barely even grazes its rural villages. Indeed, it is rare for India's rural elementary schools to have even a single working computer (Azim Premji, 2004). Amartya Sen, the Nobel Prize winning Indian economist, describes the ironic tension between possibilities and realties of Indian society. Sen (2005) explains that, "India's speed of expansion of technology products has been extraordinary . . . yet the underdevelopment of the Indian school system, especially in rural areas of the country, has been equally extraordinary, not to mention inefficient and amazingly unjust" (p. 344). Despite the inequalities, policymakers seek to develop India's elementary school system. Over the last twenty-five years, India's policymakers have shown a commitment to

universal elementary education and continue to craft policy to carry it forward. For example, in 1986, the Indian government instituted the Universalization of Elementary Education (UEE) campaign to address the challenge of providing education for all children in India (Govinda, 2007). The UEE campaign mandates 100% enrolment and retention of India's schoolchildren from ages 6 to 14. In 2002, the Indian government added the *Sarva Shiksha Abhiyan* (SSA) component to the UEE campaign. SSA was connected to India's push to meeting the United Nation's Millennium Development Goal (MDG) of providing a free, quality elementary education to all schoolchildren. While India has yet to achieve 100% enrolment, SSA has insured that all schoolchildren receive a nutritious mid-day meal, which a source of motivation for staying in school. In 2009, the Indian legislature has enforced The Right of Children to Free and Compulsory Education Act (RTE), which affirms the legal right that all Indian children have to a free elementary education. RTE empowers Indian parents with right to prosecute if their child's rights are not being upheld in schools.

UNESCO (2010) reports a steady rise in elementary school enrolment since the passage of SSA and RTE. Yet, even with the rise in enrolment, dropout rates are high (Chudgar, 2009). High illiteracy rates persist, especially among girl children (Chudgar, 2009, UNESCO, 2010). Additional challenges, like overcrowded classrooms, contribute to India's inconsistent education quality. The 2009 Annual Status of Education Report (ASER) reported that the teacher to student ratio in government run schools can range anywhere from 1:40 to 1:70. While SSA prescribes a 1 teacher to every 30 student ratio, this ratio is far from being actualized in most government run schools (ASER, 2009; NCERT, 2005). Similarly, there is a lack of proper facilities in India's million plus government run elementary schools. Almost 16% are without drinking water and 51% are without a toilet (Azim Premji Foundation, 2004). These are the

realities of India's elementary school system. However, in the face of these realities, policymakers are inquiring about the role of computer technology in addressing the inequalities and inefficiencies of India's elementary school system.

As India aspires to emerge as the information and communication technology (ICT) leader among the knowledge-based societies, it does so with the education of children as a primary concern. These aspirations reflect two strong commitments for the betterment of Indian society in the twenty first century. Abroad, India is known for its commitment to ICT and Bangalore is the place that defines the scope of that commitment. At home, India is known for a continual commitment to provide a free elementary schooling to all Indian children. One commitment reflects India's development; the other commitment reveals India's sustainability. Yet, little is known about the convergence of these two commitments; specifically, how Indian children are using ICT in elementary schools and for what purposes. While India's policymakers often expect ICT to usher in promising education changes, there is a limited understanding of how that technology is used and negotiated at the beginning level of Indian schooling: the elementary school classroom.

Rationale of the Study

The rationale for this dissertation, then, is to investigate the intersection of these two current phenomena in India: the rise of the ICT industry and the emphasis on elementary schooling. The study provides a deeper understanding of how and why Bangalore's elementary students use computer technology. The study is situated in a set of contradictions, or paradoxes, that complicate both my research questions and my findings. However, these paradoxes are critical to acknowledge and explain in order to present the realities of India.

India as a country is a paradox. India has a population of over 1 billion people and is the largest democracy in the world. Over the last decade, India has consistently had one of the world's fastest growing economies. Yet, despite this growth, one third of the world's poor live in India (UNESCO, 2008). For all the attention given to India and computer technology, the ICT industry only represents a small subset of the Indian workforce. Even though India's ICT industry is important to the Indian economy, economists estimate that only a million Indians are actually employed in an ICT field (Luce, 2007; Sen, 2006). Indians working in ICT represent only a small fraction of India's labor force, which is dwarfed by the hundreds of millions of Indians who do agricultural related work. Yet, despite this difference, the small percentage of Indians working in ICT collectively earns more annually than the hundreds of millions of Indians working in agriculture (Deb, 2011; Luce, 2007). Thus, the study's first paradox relates to the global attention paid to the Indian ICT industry, which represents a growing but still relatively small portion of the Indian workforce. Related to this paradox, I inquire about whether such attention infers something about the meanings for computer technology within India?

The study's second paradox concerns the proportion of Indian elementary schools that have computer technology. Technology in India's elementary schools is rather scarce. A little over 16% of elementary schools in India actually have a computer in the school (NUEPA, 2011). Although, private elementary schools are more likely to have a computer compared with government run public elementary schools; computers are uncommon even in India's private elementary schools (Chudgar, 2009; Chudgar & Quin, 2012). Thus, Indian elementary schools that do have computers are privileged. The study's four schools represent this second paradox of a small (but growing) subset of India's elementary school population that is equipped with at least one working computer. Even though a small percentage of India's elementary schools have

computer technology, the paradox here is even enhanced as the Indian government emphasizes the importance of computer technology in schools; sometimes over and above basic infrastructure like working toilets.

Despite the small fraction of India's workforce in ICT as well as the scarcity of computer technology in elementary schools, these two paradoxes reveal an allure of possibilities that computer technology offers to Indian society and to its education system. What is so alluring about computer technology? And how does the dissertation define and understand the term, computer technology? The allure of India's computer technology is more than just hardware and software; it is about the hope and possibilities of India's future. Such hopes and possibilities connect with the dissertation's investigation of the paradoxes of Indian society as it relates to meanings that people pin to computer technology. I sketch these meanings with a brief history. Since the Renaissance Age, people used the word "computer" to describe mathematical computations (Pelgrum & Law, 2003). By the end of the 1980s, the term "computer technology" was replaced by "IT" (information technology) in business language. This change in terminology signified a subtle, but important shift in thinking about computer technology. Computer technology went from being a super-sized calculator to a tool for processing data. Information technology was expanded to the term ICT around 1992 as e-mail and the Internet became available to the general public (Pelgrum & Law, 2003). Through this etymological evolution, computer technology morphed from being computational devices into communication tools for exchanging information. Computer technology's terminology, although changing, often describes a computer's physical properties. But, the meanings for computer technology go beyond its wares. The meanings for computer technology are attached by users, who construct purposes for computer technology. In this dissertation, I assert that computer technology is more

than just a tool; rather, as people use computer technology they assign different meanings to the technology. And the meanings that people construct for technology convey symbolic capital (Bourdieu, 1986). By symbolic capital, I mean the possibilities of power, economic opportunities, and socio-cultural status that users confer on computer technology.

Thus, the dissertation's rationale is to investigate not only the uses for computer technology in Bangalore's elementary schools, but to also explore the symbolic meanings that people assign to computer technology. Indeed, computer technology represents something more than just hardware and processing speeds. The dissertation examines a variety of these symbolic meanings, which I call "narratives," that emerge from the analysis of the dissertation's case studies. One such narrative is about the opportunity for a better life by learning the English via the computer. Another narrative is about the practicality of learning computer programming skills in order to secure an Indian middle class future. The third narrative is about the propriety of using computer technology for research and knowledge ownership. I argue that these narratives reflect Bangalore' socio-cultural context and are the ways that Bangalore's elementary students are being prepared to negotiate their future success in India's democracy. I also explore why these meanings or narratives are assigned to computer technology. Why in Indian elementary schools? And what do the narratives reveal about the Indian paradoxes that emerge in its elementary school system?

Theoretical Framework

To investigate how elementary school users assign meanings to computer technology, I ground this dissertation in social constructivist theory. While policymakers often equate computer technology with promising societal development, many support school-based computer technology investments hoping that the mere presence of computer technology might improve

student learning (Buckingham, 2007; Cuban, 2001; Pal, 2003, 2008, 2009; Thirumurthy & Sundaram, 2003; Walsham, 2010). Wilson (2002) describes that kind of thinking as technological determinism. Technological determinism is the belief that technology governs people's decision making. Technological determinists view technology as the cause for societal transformations. Bimber (1990) further identifies technological determinism as the belief that technology, rather than human action, is responsible for social change.

This dissertation is based in social constructivism rather than technological determinism. Social constructivists argue that people, rather than technology, change society. For example, a social constructivist theory of technology posits that social actors construct and negotiate the meanings for computer technology. Furthermore, a social constructivist would contend that technology has "no meaningful existence outside the context of use" (Leonardi, 2009, p. 293). Simply put, social constructivism is the belief that a technology's purpose comes from people. This dissertation's research questions and methodological approach are framed by a social constructivist theory called the Social Construction of Technology or SCOT theory. SCOT theory originated from Pinch and Bijker's (1984) case study investigation of the historical development of certain technologies. At its most basic level, SCOT theory maintains that groups of people, or social groups, construct the meanings for technology based on their interactions and negotiations.

SCOT theory offers a methodological approach for examining how people negotiate their interpretations for technology. Specifically, SCOT theory offers four heuristics, or research steps, for investigating how technological artifacts acquire meanings through social groups' negotiations. The first SCOT step requires identifying *relevant social groups*. According to Bijker (1995), relevant social groups are the actors who share space in a technology's meaning

construction. The researcher identifies these groups based on the study's context and the technology under investigation. Bijker asserts that demographic data helps to "thickly describe" (Geertz, 1973; Ryle, 1949) the relevant social groups. The dissertation's relevant social groups are fifth grade students and educators at four elementary schools in Bangalore, India.

The second SCOT step is to distinguish the relevant social groups' interpretations of technology. Bijker (1995) calls this step *interpretative flexibility* (p. 20). Interpretative flexibility is a term that is meant to describe all the different meanings that relevant social groups assign to a certain technology. SCOT asserts that interpretative flexibility is detected via each social group's rhetoric about a certain technological artifact. Thus, a key part of interpretative flexibility is to record the ways that a social group describes a technology's specific meanings and purposes. For example, a group of teenagers might share that a computer is a word processor, gaming device, and a social media tool; these different meanings make up the teenagers' interpretative flexibility about the computer.

The third SCOT step explains how the social groups negotiate their interpretative differences. SCOT theory describes this negotiation process as a technology's *stabilization.* There are different categories of stabilization that are closely tied to negotiation and the amount of power that a group holds. The categories of stabilization are: (1) consensus, where no social group dominates the other and there is a consensus about the meaning of a technology, (2) domination, where one social group dominates the "meaning making" and asserts its interpretation for the technology; and, (3) competition, where two or more social groups compete in the "meaning making" process and meaning is negotiated through competition (Bijker, 1995).

The fourth SCOT step requires a further examination of the setting's contextual factors, including the social groups' demographics, to identify the *technological frame* that the social

groups share. A technological frame takes into consideration the wider context of cultural and socio-economic factors that influence a technology's social construction in specific settings (Bijker, 1995; Klein & Kleinman, 2002). A technological frame also reflects the interactions among social groups in a particular context. According to SCOT theory, the technological frame is a frame of reference among the social groups in a particular setting that represents how the social groups make sense of a technology in relationship to the context they share. The technological frame helps to explain the interpretative flexibility and why social groups negotiate certain meanings for computer technology based on their social context. The technological frame provides deeper, contextual levels of understanding about the social shaping of technology.

In sum, I use SCOT theory to guide the investigation of how social groups in Bangalore's elementary school assign and negotiate meaning for their school's computer technology. Given the importance of Bangalore within the global society, I employ SCOT theory to further probe the uses and socio-cultural context for computer technology in Bangalore's elementary schools.

Research Questions

The dissertation's two primary research questions are: (a) How and why is computer technology socially constructed in Bangalore's elementary schools? (b) How does the social construction of technology compare across schools? To systematically organize these primary research questions, I parse the questions into research sub-questions based on SCOT theory's heuristics:

1. Who are the relevant social groups and what is the social context like in the study's elementary schools?
2. What meanings do the study's relevant social groups (students and teachers) assign to computer technology?

3. How do the relevant social groups in each setting negotiate the meaning for computer technology use? To what degree is there stabilization?
4. How does the school's social context, including the relevant social groups' demographics, help explain the meaning they assign and negotiate to computer technology?

Context of the Study

Alexander (2003) describes India as being a "young democracy shaped by a culturally ancient" society (p. 88). I investigate the dissertation's research questions within Alexander's notion of the sociological tapestry that defines India. In order to provide deeper contextual understanding, I discuss background information about India's elementary school system. Additionally, I explore two themes, English language and social class, that are important to understanding the larger Indian context of this study.

India's elementary school system. India's elementary school system is complex. Elementary education in India means eight years of schooling from the time a child is six years old. In India, elementary school is defined as the time period between first and eighth grades (NCERT, 1999). There are almost 2 million elementary schools spread across 35 Indian states and union territories (MHRD, 2010). Almost 80% of India's elementary schools are public, government run schools. In most government run public schools the language of instruction is the state language. For example, teachers in government run public schools in the State of Karnataka primarily instruct in Kannada, the language of Karnataka. While the language of instruction differs from state to state, all government run public schools follow a national prescribed curriculum. The National Council for Educational Research and Training (NCERT) is charged by the Indian government to "prepare, promote, oversee, and establish a national system of education in India" (NCERT, 1988, p. 3). While NCERT mandates that government

run public elementary schools must include the subject matter areas of languages, mathematics, science, and social science, the council allows for the curriculum to be somewhat tailored to "local needs based on socio-political pressures" (NCERT, 1998, p. 80). This is especially true when it comes to the mandate for the teaching of three core languages. While the typical three core language formula includes the regional language, English, and Hindi, it is up to local district officials to make the final decision of what languages are taught. Typically, language instruction makes up 32% of the daily classroom time and mathematics makes up 14% of the daily schedule.

Governing boards deliver India's National Curriculum. The governing boards are a form of legitimatizing the curriculum and conferring status. Indeed, there is a high degree of public opinion about the rigor of each governing board. Posters on telephone poles advertising a school's affiliation to an Indian governing board are quite common throughout India. Table 1 lists the type of governing boards in India, provides the board's acronym, and indicates the public status and school type affiliated with the governing board (NCERT, 2005).

Table 1

India's Educational Governing Boards

Governing Board Name	Acronym	Status and School Affiliation
Central Board of Secondary Education	CBSE	High- Private & Public
Council for Indian School Certificate Examination	ICSE	Medium – Private & Public
International Baccalaureate	IB	Exclusive – Private Schools
National Institute of Open School Syllabus	NIOS	Medium – Private Schools
Islamic Madrasah School Syllabus	-	Muslim – Private Schools
State Board of Education Syllabus	SSBE	Low – Public Schools

As Table 1 shows, the Indian public confers a low status on the State Board of Education's Syllabus (SSBE). The public views SSBE as an inferior education because of the lack of English instruction and the lack of rigor in the state's curriculum (Advani, 2009; Kumar, 1991; Thapan, 1991). Kumar (2009) explains that Indian parents see private schools as a status symbol. Conversely, public school education is de-valued because of the mistrust that many Indians share about government managed institutions. Private schools are a symbol of prestige and cultural capital (Bourdieu, 1984; Sarangapani, 2003; Thapan, 1991). A private school's governing board affiliation adds to this cultural capital. Over 20% of the elementary schools in India are private (ASER, 2009). The Indian government officially recognizes private schools and classifies private schools into two categories: aided or unaided. Private aided schools accept government funds. Conversely, private unaided schools do not accept government funds and are completely funded by private parties (Govinda, 2007). In the context of the dissertation's four participant schools: one school is public, government-run affiliated; one school is private aided; and two schools are private unaided.

English language. English is the primary language of instruction in most of India's private elementary schools. English language learning is an important, albeit controversial, dimension of Indian elementary schooling. Indian English, as Ramachandra Guha (2007) calls it, represents India's mixed identity. English is a vestige of colonialism but a pathway to privilege and economic security. English is India's business language. And, yet, many Indians worry that the English language threatens India's unique regional cultures and identities. The hegemony of the English language is situated in the language's power to dominate political, economic, and cultural arrangements in a globalized society. Advani (2009) argues that the narrative of English in the Indian education system reflects "a variety of discourses including the language of

colonialism, pan-Indianism, and globalization" (p. 2). Globalization has driven the demand for a universal mode of communication. English meets that demand. Advani posits that English is the medium of the global economy. It is required for landing a decent job and esteemed as the entry ticket into India's growing middle class. One can see this narrative unfold in Indian popular culture, especially as depicted in the Indian popular media.

Summarizing the role of English in relationship to Indian society, Advani (2009) simply states, "English education has increasingly become an object of desire for all" (p. 48). There is an economic advantage attached to learning English. In my study, the participants often referenced and reiterated the advantage of knowing English. Indeed, the coupling of computer technology skills with command of the English language is a pervasive theme throughout this study. At two schools in particular, the students perceived that English language was the symbolic capital that computer technology provided.

Social class. Another theme in this study is the relationship between social class and the meanings that students assigned to computer technology. As a culturally ancient society, India has retained both positive and negative vestiges of antiquity. Guha (2008) explains that two of the more lasting cultural vestiges are the divisions among caste and class. In India, social class is complex and difficult to define. For the dissertation, I rely on Beteille's (2007) and Sen's (2005) understanding that, in India, social class is a federation of cultural, economical, political, and social arrangements. A social group's social class confers their socio-economic status (SES). In this dissertation, social class and SES will be used in synonymous ways. Beteille (2007) suggests that India's social class arrangements reinforce societal power structures and can be divided, though not easily, into three strata: lower class, middle class, and upper class. A lower class distinction are Indians who are often very poor, they own few possessions, and labor, for

very small wages, in non-skilled jobs. The Indian middle class distinction are people who a skilled workers, they usually work for a salary, and they own many personal possessions. India's upper class people are wealthy and own even more possessions, including major possessions such as businesses.

India's social class distinctions must also be examined in the historical context of its caste system. While this dissertation focuses mostly on social class, caste identity continues to be a sociological complexity of Indian life (Hickey & Stratton, 2007). After one's mother tongue, caste is the principal way in which Indians identify themselves (Guha, 2008). Thapar (2003) explains that the origins of the caste system revolve around two Sanskrit words, *varna* and *jaita*. Varna is the word for purity, but its meaning has more to do with a hierarchy or division of purity. Jaita is the Sanskrit word for birth. Taken together, varna and jaita shape the meaning of caste system which is the hierarchy of purity which people are born into. The caste birthright is an important difference between caste and class. People are born into their caste and, therefore, cannot move between castes.

While discrimination based upon caste is now illegal in India, social inequality is still common and reflected in India's school system (Hickey & Stratton, 2007). Rao, Cheno, and Narain (2003) assert that many middle class Indians believe that "lower castes are not deserving of education and this belief is deeply rooted in caste discrimination and hampers the efforts to universalize elementary education" (p. 173). The rootedness of caste within Indian society makes the need for free and universal elementary education all the more necessary, yet, at the same time all the more challenging. The challenge is how to overcome such a strong cultural construct that affects the way in which elementary schooling is both conceived and organized. This is India's challenge for the twenty-first century.

Summary: situating the dissertation. Against the backdrop of Bangalore, the dissertation explores the confluence of India's commitment to ICT and to elementary schooling. Within this confluence, issues like the role of English and the rootedness of social class are part of the dissertation's investigation of the social shaping of technology in Bangalore's elementary schools. Throughout the dissertation these contextual issues repeatedly get entangled with the uses and meanings for computer technology in the study's four schools.

This dissertation does *more* than just tell of the ways elementary schools in Bangalore use computer technology. Indeed, the dissertation does not pretend that computer technology is separated from the school's socio-contextual fabric. Rather, the dissertation examines how Bangalore's elementary school participants construct meaning for computer technology in relationship to their school's socio-cultural context or what SCOT theory calls, their technological frame. Through this examination, the dissertation investigates how the participants' meanings for computer technology are connected to socio-cultural relationships like: (a) the coordination of Indian democracy and education; (b) the divide between Bangalore's urban and rural areas; (c) identity and English language instruction; (d) the provision of resources to address social inequalities; and (e) social class and economic opportunities. Furthermore, the dissertation examines how the participants' meanings also shed light on two paradoxes of the larger Indian society. The first paradox is the ever growing global attention paid to the Indian ICT industry even though this industry only makes up a small percentage of India's labor market. The second paradox is the Indian government's increasing emphasis on computer technology in elementary schools, even though only a small proportion of India's elementary schools are equipped with such technology.

Dissertation's Chapter Organization

I close this chapter by laying out the dissertation's organization. Chapter 2 is a literature review about the ways in which elementary schools in India are using computer technology. Chapter 3 describes the dissertation's setting and method in more detail. It also describes the study's participants, data collection methods, data analysis, and the limitations.

Chapter 4 through Chapter 7 are the schools' case study chapters. Specifically, Chapter 4 describes the social construction of technology at Bara National School, which is a private, middle class school affiliated with the CBSE. Chapter 5 reports on the social construction of technology at Jinka Public School, which is the study's government-run public school affiliated with the State of Karnataka's SSBE. Chapter 6 examines the social construction of technology at Aadu International School, which is a private, upper class school affiliated with the International Baccalaureate (IB) curriculum. Chapter 7 explains the social construction of technology at Komu Community, which is the "daughter school" of Aadu International and is a private community school for lower class village students.

In Chapter 8, I compare the schools via a cross-case analysis related to the SCOT themes and the dissertation's primary research questions. Chapter 8 includes a deeper examination of how the case studies reflect the wider sociotechnical context of Bangalore, India. Chapter 9 is the dissertation's conclusion that revisits the Bangalore Challenge, situates my findings in the literature, suggests the study's further research opportunities, and discusses the significance of this study.

CHAPTER 2

LITERATURE REVIEW

While there is considerable interest in utilizing computer technology to raise student achievement; educators and policymakers, in India and around the world, are unclear about the most effective way to support computer technology related programs in schools. Despite all the goals and promises related to computer technology, there are many barriers that constrain the ways that elementary school teachers and students use computer technology in school classrooms (Hew & Brush, 2007). In this chapter, I review the scholarship on the uses for information and communication technology (ICT) in India's elementary schools.

ICT Use in India's Elementary Schools

India provides a compelling case study in examining ICT and elementary schooling. The Indian government is exploring ways in which educators can use ICT to address the realities of elementary school education in India (NCTE, 2009). Yet, despite the promises of increased ICT investment, little is know about the ways in which India's elementary school teachers and students use technology. Additionally, there is a paucity of empirical research related to ICT and elementary education in India.

After extensive searches on various academic search engines, I could only identify 14 empirical based studies, published in the 2000's, that were related to ICT and elementary schooling in India (Azim Premji Foundation, 2008; Banerjee, Cole, Duflo, & Linden, 2007; Bharadwaj, 2007; Iyer & Baru, 2008; Kam, Kumar, Jain, Mathur, & Canny, 2010; Karnati, 2008; Light, 2009; Linden & Banerjee, 2003; Mehta, 2005; Pal, 2009; Patra, Pal, Nedevschi, Plauche, & Pawar, 2007; Pawar, Pal, & Toyama, 2006; Thirumurthy & Sundaram, 2003; Umrani-Khan & Iyer, 2008). Of the fourteen articles, one study is a dissertation (Karnati, 2008) and four studies

are from peer-reviewed journals (Banerjee et al., 2007; Light, 2009; Pal, 2009; Thirumurthy & Sundaram, 2003). The other ten studies are either from conference proceedings or working papers and reports for international organizations. I include these studies because their descriptive data shed light on the barriers to ICT use in India's elementary schools. Additionally, I include other literature (e.g., Azim Premji Foundation, 2004; NCERT, 2005) to provide further contextual understandings. I describe and explain the following three barriers to ICT use in India's elementary school: lack of resources, lack of teacher preparation, and a lack of local understandings. I also examine strategies, from the literature, for addressing each barrier.

Barrier 1: lack of resources. India's National Curriculum Framework 2005 states that, "the significance of ICT has been widely recognized, but the detailed guidelines and strategies for its educationally optimum use has not yet been worked out" (NCERT, 2005, p. 92). NCERT (2005) further points out the irony of India's ICT prowess, but the dismal lack of ICT resources in India's elementary schools. Mehta (2005) found that Indian urban elementary schools were four times more likely to have ICT compared to rural schools. Bharadwaj's (2007) study of 1,000 ICT equipped elementary schools revealed fewer than six computers per school or about one computer for seventy two students. Less than 9% of the teachers in the schools surveyed had access to the Internet, whether at school or outside (Bharadwaj, 2007). Where computers are available in India's elementary schools, the emphasis is largely on acquiring computer literacy skills (Iyer & Baru, 2008). ICT is commonly taught as a separate class rather than being integrated into the subject matter (Adeya, 2002; Ahuja, 2000; Iyer & Baru, 2008).

Thirumurthy and Sundaram (2003) compared how teachers used ICT in six different elementary schools. There were no computers in the classrooms in any of the schools; instead children were taken to a computer lab, arranged in groups of three or four, and took turns playing

drill and practice games on the computer (Thirumurthy & Sundaram, 2003). Umrani-Khan and Iyer (2009) reported that sharing computer hardware is a common occurrence in India's elementary school computer labs. Thus, at ICT equipped elementary schools, there tends to be an overcrowding of resources. Whether it be cell phones (Kam et al., 2010), computer mice (Pawar et al., 2006), or software (Azim Premji Foundation, 2008; Banerjee et al., 2007; Linden & Banerjee, 2003; Pal, 2009; Patra et al., 2007) it is common for large groups of students to share technology resources.

Addressing the lack of resources barrier. While there can be social benefits from sharing, a child's actual learning time or time on task with the technology is limited (Kam et al., 2010). While computer equipment and hardware are scarce, the Indian government makes a considerable investment in educational software through a partnership program called CAL. In this program non-governmental organizations (NGO), like the Azim Premji Foundation, provide computer hardware and educational software CDs to government run public elementary schools. In exchange, the elementary school provides or creates space in their school for a computer lab, called a Computer Aided Learning Center (CALC). Outside of school hours, the CALC becomes a computer center, where community residents can pay a small fee and have access to the computers.

During the school hours, each teacher is required to regularly take her students to the CALC where the students learn computer literacy skills through an integrated, educational software series. The software CDs have lessons aligned with the Indian National Curriculum. Most of the CDs are written in English, some are also produced in local languages (Karnati, 2008). Pal (2009) reports that, "CAL projects are active in over 20,000 public primary schools in India. CAL aids the curricular program in schools and typically include a computer center

with three to five machines set up per primary school of about 200–400 children in a rough 1:50 machine/child ratio" (p. 1387). Pal's (2009) qualitative study included an analysis of stake-holders' perceptions to CAL projects. Findings from the study suggest that even though students had to share the ICT equipment they were still eager to learn with the aid of the computer. Similarly, in Pal's study parents viewed ICT as a public good that should be in schools rather than at homes and shared by schoolchildren (Pal, 2009; Pawar et al., 2007).

Additional studies (Azim Premji Foundation, 2008; Banerjee et al., 2007; Linden & Banerjee, 2003) related to CAL confirms that India's education stakeholders, mostly parents, have a positive view about any kind of technology which their child gets to use, even if means the child has to share. The CAL findings offer a glimpse into an important distinction related to ICT investment in Indian elementary schools. ICT software, rather than equipment and hardware, is prioritized by the Indian government for addressing the resource scarcity; since the software can be designed in a way that multiple learners can access it from a single computer.

Barrier 2: lack of teacher preparation. While Indian parents view student ICT use as positive, Indian elementary teachers' computer technology perceptions are more nebulous (Azim Premji Foundation, 2008; Iyer & Baru, 2008; Thirumurthy & Sundaram, 2003). While many elementary teachers perceive ICT as motivating for students (Iyer & Baru, 2008), others perceive computer technology apprehensively and focus on the challenges (Azim Premji Foundation, 2008; Thirumurthy & Sundaram, 2003). One such challenge is the perceived lack of computer training. This echoes what Law et al. (2008) reported from the large scale, multi-country ICT study. Law et al. identified factors which affect teachers' computer technology perceptions. One factor is support. Teachers who feel supported, both technically and administratively, are more likely to have a positive perception of computer technology. The literature reveals the

computer equipment issues, “overcrowding” of resources, and lack of training are factors leave many of India’s elementary teacher feeling indifferent about ICT (Azim Premji Foundation, 2008; Bharadwaj, 2007; Iyer & Baru, 2008; Thirumurthy & Sundaram, 2003).

For example, Thirumurthy and Sundaram (2003) found that “teachers often express a stream of concerns about ICT and curriculum integration, namely: misuse, overuse, and overstimulation” (p. 309). While some teachers believe that children will benefit the most only when curriculum is integrated with ICT, most teachers felt stifled by ICT and believed it was additional work. Other teachers communicated feeling incompetent to use ICT and were not satisfied with minimal ICT training and preparation they received when in college. The Azim Premji Foundation (2008) study shared similar findings. They found that the elementary teachers believed that ICT required additional training and work to be able to use ICT effectively.

***Addressing the teacher preparation barrier*.** While there is not a lot of empirical research on how Indian elementary teachers are being prepared to use ICT, the literature indicates that there are several corporate sponsored projects focused on preparing India’s elementary teachers to teach with technology. Many of these projects are spearheaded by private ICT companies such as Dell Computers, Intel, and Microsoft (Aggarwal, 2009; Light, 2009; Mathur, 2007; Suckow, 2010). Dell’s program, called the ‘connected classroom’, invests in low cost notebook computers for Indian elementary teacher and students to use in the classroom. Part of this program includes an online training module for preparing teachers to use the laptops in a ‘connected classroom’ (Aggarwal, 2009). Intel’s initiative is called Teach to the Future Program. This program supports Indian elementary teachers with both face-to-face and online instructional for how to teach with technology (Light, 2009; Suckow, 2010). Another example is Microsoft’s Project Shiksha, also called “Empowering the Future” project (Suckow, 2010). Through Project

Shiksha, Microsoft provides inexpensive software, in depth training, and packaged ICT curriculum. While these programs seem to contribute to the preparation of Indian elementary teachers to teach with technology, there is a lack of empirical studies about each program's effectiveness. Thus, it is difficult to measure or begin to posit what kind of impact the programs can have in relationship to elementary school teacher education in India.

Barrier 3: Lack of local understandings. Most of the research about ICT use in elementary schools comes from developed nations. Generally, there is a lack of education research in developing nations (Light, 2009; Pal, 2003, 2008; Patra et al., 2007; Walsham, 2010). While Indian policymakers expect ICT to usher in promising education changes, they have a limited understanding of how that technology is negotiated in elementary school classrooms. Patra et al. (2007) identify this as a product of squeezing macro-level policy expectations into micro-level contexts. At the local school level, there is also a lack of research about the meanings Indian teachers and students assign to computer technology (Light, 2009; Pal, 2008; Patra et al., 2007; Walsham, 2010). Researchers have yet to analyze the differences in Indian teachers' and students' interpretations regarding ICT's educational purposes (Pal, 2008, 2009). Consequently, it remains unclear how and why computer technology is negotiated in India's most basic schooling unit: the elementary school classroom. Identifying and analyzing this discourse addresses the need to develop frames of reference towards a deeper and more collaborative understanding for elementary school computer use (MHRD, 2009b).

Addressing the local understandings barrier. Patra et al. identify that socio-cultural contextual knowledge is missing in much of the empirical research on ICT use in India's elementary schools. Along with Pal (2008), they recommend that researchers, in developing nations, include detailed descriptions of their study's context. Patra et al. provide examples of

such description in their study on the different types of computer usage models across India. Additionally, several researchers recommend case study research design as a way to address the lack of local understandings (Hew & Brush, 2007; Light, 2009; Pal, 2003, 2009; Patra et al., 2007, Wilson, 2002).

Summary of the literature on ICT in India. I reviewed 14 studies and identified three barriers to elementary school ICT programs in India: lack of resources, lack of teacher preparation, and a lack of local understandings. Although I described the barriers separately, in reality the barriers are interrelated. Thirumurthy and Sundaram (2003) explained how overcrowded ICT resources affected teachers' attitude about using such resources. Conversely, the gap in literature regarding local understandings of teachers' ICT knowledge and skills, for example, correlates with the teacher preparation barriers. In sum, this literature review suggests that there is a relationship between India's elementary school-based ICT program failure and overcrowded resources, teacher attitudes and preparation, and localized contextual understanding.

Like with any research findings, though, there are some caveats. While I focus this review on barriers to elementary school-based ICT programs in India, it does not speak to all the complexities that define ICT use in India's elementary school system. Other factors, such as class size, school infrastructure, and administrative support, are likely barriers, as well. Additionally, the review does not capture all the complex realities of the Indian elementary school system. For example, UNESCO (2008) reports that the Indian public elementary school system is plagued by an inconsistent quality of education. Overcrowded classrooms and a lack of proper facilities pose not only a learning risk but also a health risk. For government run public schools in India, UNESCO estimates that 7% of the schools do not even have one functional blackboard, 16% are without drinking water, and 51% are without a toilet. GESCI

(2008) also cited that a consistent source of electrical power was a luxury which only India's elite private schools enjoy. When faced with these kinds of barriers, perhaps a better question to ask is: How do elementary school-based ICT programs in India even succeed?

Nevertheless, this review of technology use in India's elementary schools offers three implications. First, it sheds light on the issue of ICT resource scarcity in India's elementary schools. Having the world's second largest population, resource scarcity is already a political and economic problem in India. Scarcity affects all aspects of Indian society. More independent research is needed about the types of Public Private Partnerships (PPP) that exist in India, as well as, the kind of impact these programs have on elementary schooling. Additionally, expanding understanding about creative solutions to share educational technology resources, like the multiple-mice project, will become increasingly more important as India emerges a leader in the knowledge society. Such understanding is developed with more empirical research.

Second, there are implications related to preparing India's teachers to use ICT in their practice. So what does teacher preparation and "buy in" look like in India, where there are estimated to be a million teacher vacancies within the next five years? Indian policymakers are currently exploring ways in teacher education programs can utilize ICT the realities of preparing India's elementary teachers (NCTE, 2009). Policymakers would be wise to not only look at the types of ICT hardware and software that can assist in this preparation, but also consider the technological mindset being developed by a future crop of elementary teachers. A model like Mishra and Koehler's (2006, 2009) technological, pedagogical, and content knowledge (TPACK) framework could prove to be instructive and fruitful to the challenge of preparing so many teachers to use technology. TPACK explains the relationship among the following three types of knowledge for teaching with technology: content, pedagogy, and technology. TPACK

is useful for identifying the knowledge required by teachers for connecting instructional technology to teaching and content. Preparing India's future elementary teachers requires not only ICT resources, but also a mindset for how to integrate ICT with subject matter content and pedagogical practice for educationally profitable outcomes

Third, and perhaps most pressing, is the need for more empirical research on ICT use in India's elementary schools. For as important as the ICT industry is to India, there is a dismal lack of empirical research on ICT use in India's education system. This implication also speaks to the kind of scholarship represented in much of the literature on school-based ICT programs in developing nations (Light, 2010; Pal, 2008; Walsham, 2010). Not only is there a lack of research on ICT in India's elementary school context, but the existing scholarship is inconsistent in its rigor. For example, many studies that I reviewed did not include a complete description of methodology or even the research questions. Only two of the thirteen studies actually grounded the research in a stated theoretical framework (Pal, 2009; Patra et al., 2007). Few of the studies included a description of the research design. While there are a number of research designs, like case study, that could help a researcher systematically investigate local understandings; what would be most helpful to the larger field is if future research conforms to a disciplined inquiry.

Going Forward: The Dissertation's Inquiry

This dissertation seeks to address the "lack of local understandings" barrier through a disciplined study of four elementary schools in Bangalore. Yet, what is a disciplined inquiry? Lee Shulman (1988) explains that a disciplined inquiry "follows a set of rules and principles for pursuing an investigation . . . the inquiry emerges from underlying social or natural science disciplines which have well-developed canons of discovery and verification for making and rating truth claims" (p. 18). What Shulman argues for is a systematic pursuit of knowledge in

educational research. Such research is marked by an explanation of the theoretical constructs that inform the research. Disciplined inquiry also includes a methodology description and a clear analysis for reporting research findings. To close this paper, I provide an outline of how the dissertation conforms to a disciplined inquiry.

I begin with a story. In early April 2010, I received an e-mail invitation from the World Bank asking me to electronically "attend" an Oxford style debate webinar located in New Delhi, India. The debate's motion simply stated, "Most investment in technology in schools is wasted. Discuss." I was intrigued by the statement and decided to listen in for awhile. Each side was well represented by educators and policymakers. Many of the discussants offered quite persuasive arguments, yet most were anecdotal accounts of wasted ICT investments in schools. For example, one discussant shared about a small Indian village school that received a dozen computers from a corporate sponsor. The computers were all neatly packed in boxes and shipped to the school. A year later, a corporate representative came to visit the school and found the computers tucked away in a classroom still all neatly packed in their boxes. The boxes were never opened because the school was still waiting for electricity.

While this makes for a compelling story, I think the debate also offers a metaphor for the current state of school-based ICT research in developing nations like India. Like the arguments from the New Delhi debate, too much of the field's research remains anecdotal because of the lack of a disciplined inquiry. While anecdotes over hard evidence might make for appealing newspaper reading, anecdotes, alone, do not move the field forward. Theories do, however, and so do strong research methodologies. Thus, the dissertation is grounded in a strong theoretical framework, SCOT theory, as a first step towards a disciplined inquiry in this field. Kurt Lewin (1952) said, "Nothing is so practical, as a good theory" (p. 169). This dictum provides the first

recommendation: frame the research in theory. A theoretical framework helps the researcher to interpret the data. Melnyk and Handfield (1998) explain that a benefit of using theory is that, "research become less a matter of 'hit or miss' and more a targeted and purposeful search" (p. 312). Regrettably, much of the research surrounding school-based ICT use in developing nations seems to be rather aimless.

This is worrisome considering the prevalence of technological deterministic language within the field's literature. SCOT theory provides both a theoretical framework and a methodological approach for investigating how elementary schools use computer technology. Rather than focusing on ICT, SCOT shifts the focus to the uses for ICT. The strength of SCOT theory, though, is that it also offers a methodological approach for examining how people negotiate meaning for technology. SCOT's four step approach includes: (1) identifying the relevant social groups who share space in a technology's meaning construction; (2) examine each group's interpretative flexibility, which is their rhetoric about the purposes for using the technology; (3) investigate how the social groups negotiate their interpretative differences; and (4) examine each social group's demographics or "technological frame" in relationship to their interpretative flexibility (Bijker, 1997). SCOT theory is fruitful in that it disciplines the dissertation's research inquiry with both a theoretical framework and a methodological approach for studying the phenomenon of school-based ICT use in Bangalore.

Policymakers and government leaders continue to inquire about the many barriers to school-based ICT programs in developing nations like India. They debate whether ICT investment in school is wasted. While ICTs are twenty-first century tools, they are still only tools. In schools, teachers and students give purpose and meaning to these tools. They have difficulty knowing how or why to use the tools. A disciplined research agenda, based on a

strong theoretical framework around the SCOT theory can help to uncover the complexity of using ICT in India's elementary schools. Lest the computers remain in neatly packed boxes, such research would also shed light on the meanings and purposes that teachers and students have for using ICT. Such research helps to explain the barriers to using ICT, as well as, the innovative ways that teachers and students construct meaning for the technological tools they use.

CHAPTER 3

METHOD

I will never forget the question, "Sir, where is your village, sir?" A 10 year old, rural Bangalorean girl asked me this question as I sat down to share a mid-day meal of rice and daal at Komu Community School, a village school in my study. I was struck by her question because while I was living in Bangalore at the time, I certainly felt like my village was closer to East Lansing, Michigan, than to Ulsoor Lake District where my flat was located. I honestly did not know how to answer her simple question. So I stammered, "Well, my village is in Michigan in the United States of America and it is also in Bangalore." Suddenly, I was the one being interviewed. The 10 year old continued her inquiry, "Sir, sir, you mean you live in two villages, sir?" I had to pause and reflect: What did I actually mean? The girl repeated, "Sir, you live in two villages, sir?" Smiling, I nodded and replied, "Yes, I suppose I do."

Doing field research means living in two villages. As the researcher I lived in my research setting, Bangalore, and I also resided in my training ground: the College of Education at Michigan State University. Geertz (1988) called this the challenge of "sounding like a pilgrim and a cartographer at the same time" (p. 10). Michael Agar (1996) likened this phenomenon to being a "professional stranger." What Agar meant is that the researcher is a professional in that she or he is trained, and mentored, in the science of research. Such science includes a disciplined methodology to ground the research. And I learned this science at the university.

Yet, the researcher is also a stranger and has to figure out the art of gaining access to the study's people and places. As I would come to find out through the course of my study, the art of research is best learned by being in the field. For example, I found that the teacher participants were often put at ease when I let them know about my own teaching background as a

fifth grade teacher. One teacher even replied, "Oh, good, so you understand what it can be like to teach." Also, when I mentioned to the teachers that Shalini, my wife, was from India, it was another way of establishing a commonality. I believe all the teachers were more open (and welcoming) of my presence in their classrooms because of these shared experiences. Gaining access and the participants' trust is part of the art of research. Once immersed into the study's classrooms, though, I relied on the science of research to systematically guide my investigation.

The Setting: Bangalore, Karnataka, India

In order to begin my investigation I also needed to be immersed in the setting of Bangalore. Located in Southern India, Bangalore is the country's third most populous city. Bangalore is also the capital of the Indian State of Karnataka, which is the ninth most populous state of India's 28 states and 7 union territories. Despite Bangalore's reputation as hub for technology, the State of Karnataka's economy is still rural and agrarian based. Like most Indian states, Karnataka has its own state language called Kannada. In 1956, the Indian government formed Karnataka as a state that was to be an example of linguistic unity. Today, Kannada is the mother tongue for more than 70% of people living in Karnataka (Rao, 2007). Kannada is the primary language spoken by vendors, bus drivers, and auto rickshaw drivers. Additionally, Kannada is the medium of instruction in Karnataka's government run public schools.

The State of Karnataka is somewhat fractured because of its multilingualism. Even though Kannada unifies much of the Karnataka countryside, English is the spoken tongue in Karnataka's urban high-rise apartments, technology centers, shopping malls, and private schools. Guha (2007) describes how English has become the language of the Indian elite. English is the fuel for the engine of India's economic growth. One of the unintended consequences of India's economic growth is the deepening rift between India's urban and rural areas. As the fissure

widens, India's disparities and inequalities are revealed. Sen (2005) illustrates the disparity by describing India as if a portion of the Indian population lived as though they were on the San Diego shores, while another segment of the population live as they were in the sands of Somalia. Karnataka reflects the extensive gulf between India's rich and poor; a breach that is most prominent between the state's urban and rural areas.

Although Karnataka's total rural population (66%) is almost twice the percentage of Karnataka's urban population (34%), the urban population enjoys a better standard of living and higher wages compared to rural Karnataka (Deb, 2010). There is resentment in Karnataka's rural areas about cultural and linguistic identity loss (Rao, 2007). To seize upon the political will such resentment often represents, the Karnataka government has tried to enforce legislation that would make Kannada the primary language of instruction in all of Karnataka's elementary schools regardless of their public or private affiliation (Advani, 2009). The federal relationship between Bangalore and Karnataka is a window into understanding the tension in India between the ancient and the modern, the rural and the urban, and retaining a local cultural identity versus becoming cosmopolitan. These tensions played out in unique ways at the study's four schools.

The Sample

The dissertation's sample was drawn from four elementary schools in Bangalore. The target population at each school was fifth grade students and their teachers. The majority student population at each of the four schools represents a particular socio-economic class. I selected the fifth grade age range because that is when children begin to acquire experimental design skills that lead to more advanced computer skills (Zimmerman, 2007). To investigate the study's research questions, it was also important that the students could verbalize their interpretations for the computer's main purposes. Across the four schools, the total participant sample was 237

fifth grade students and 15 educators. By educators I mean the school professionals who were also part of the curriculum and instruction of the study's fifth grade students. Of the 15 educators, 12 were either fifth grade teachers or fifth grade computer science teachers.

I used convenience sampling to arrange my field research at each school. I selected the schools based on three criteria. First, each school had to be located either in the city of Bangalore or within the rural Bangalore environs. Second, the schools had to have some form of computer technology, like a computer lab or laptops. Third, the school's majority student population was to be representative of a particular socio-economic class. Table 2 describes each school by its demographic description and sample size.

Table 2

The Dissertation's School Descriptions

School	Type/Demographic Description	Sample
Jinka Public School	Government-run, lower SES, rural	Students: 11 Educators: 3
Komu Community School	Private, lower SES, rural/urban mix	Students: 50 Educators: 5
Bara National School	Private, middle SES, urban	Students: 110 Educators: 3
Aadu International School	Private, upper SES, urban	Students: 66 Educators: 4

The demographic differences among the four schools allowed for comparisons across a range of context. I provide a brief description of each school, in the order that each school appears in the case study chapters. To protect identity, all the schools, as well as the participants, are reported as pseudonyms.

Bara National School. Bara National School is a private school located in a large middle class neighborhood in Bangalore. More than 1000 students are enrolled. Each grade level has at least three sections and each class size is capped at 40 students. Fifth grade enrollment equals 110 students divided among three teachers. Bara National follows the Central Board of Secondary Education (CBSE) curriculum. In accordance with CBSE, Bara National implements a highly scripted computer science curriculum, which, starting at the first grade level, includes a scope and sequence for all 12 years of education at Bara National. The computer science teachers focus the curriculum on computer skills training and learning how to code in variety of computer languages. For 45 minutes each week, the fifth grade students at Bara National go to the school's computer laboratory for their computer science class. The fifth grade students' computer use is focused on learning application software like Microsoft Word and Microsoft PowerPoint.

Jinka Public School. Jinka Public is a government-run public school that is located about 25 kilometers from Bangalore's city center. The student population at Jinka Public represents a low socio-economic status school in Bangalore. While Jinka Public is part of rural Bangalore, the school is situated in a village that, culturally, seems quite removed from the hustle and bustle of Bangalore. A Kannada medium school, Jinka Public serves about 60 students living in the Jinka village. Jinka Public is a "one laptop" school, which means they have single laptop that the whole school community shares. The laptop was provided through a Public-Private Partnership program with a Bangalore based non-governmental organization (NGO). The "one laptop per school" is a scheme that supports the effort to maintain consistent attendance among the school's upper elementary students. Jinka Public's teachers explained that the laptop kept the students motivated to attend school. Additionally, it was also an incentive for

the parents, most of whom were day laborers or seasonal field workers, to keep sending their children to the school. Jinka Public School is affiliated to the Karnataka State Board of Education Syllabus (SSBE) and the government of Karnataka provides the curriculum materials.

Aadu International School. Aadu International School, a school for Bangalore's wealthiest families, is a private school on the outer edge of Bangalore. It is a highly ranked and highly selective school. The school's enrollment is over 950 students (preschool to twelfth grade). The school serves as a boarding hostel for many students whose parents are diplomats or foreign officials. Each grade level has three sections and each class size is capped at no more than 25 students. Together, the fifth grade enrollment equals 66 students divided among three teachers. Aadu International's mission is to provide an inquiry-based curriculum that guides students in becoming the "leaders of tomorrow," which is part of school's mission statement. Technology wise, Aadu International's fifth grade students use the school's computer laboratory and have access to a set of classroom laptops. Aadu International is affiliated with the International Baccalaureate Program (IB). The medium of the instruction is English. The population at this school represents Bangalore's upper socio-economic status.

Komu Community School. Komu Community School is a "daughter" school of Aadu International. Komu Community is a private school and represents the lower social economic status. The school's student population is a mix of urban and rural students. Komu Community was founded in response to the Right of Children to Free and Compulsory Education Act (RTE). The act mandates that all private elementary schools (Classes I – VIII) reserve 25% of their class strength to underprivileged children. Private schools have options regarding their adherence to this law. One option is to provide "Equal Opportunity Schools" where underprivileged are provided a quality education but in a separate school building. Komu Community is an example

of one of these Equal Opportunity Schools. The school is located about kilometer from Aadu International's main campus. The students who attend Komu Community come from villages within a five kilometer radius of the school. Komu Community has a one-to-one laptop program. Each fifth grade student has his or her own laptop to use at the school. Komu Community also represents the increasingly popular "community" school model. In community schools, there is a commitment to teaching about the community and "local" knowledge.

Research Design

As I explained in the first chapter, I frame this dissertation in SCOT theory, which asserts that people, in their social contexts, construct and give meaning to things (Bijker, 1995; Piaget, 1974; Pinch & Bijker, 1984). The study is further premised on Max Weber's (1947) assertion that no thing is significant in itself until a person gives it meaning. In other words, it is people who give meaning and significance to things like computers or computer technology. In designing this study, I build upon these premises of social constructivism by grounding the dissertation's methodological approach in SCOT theory and case study research design.

According to Yin (1994, 2008) case study is a research design for empirical inquiry that allows for the investigation of complex phenomena within in an authentic context. The strength of case study research design is that it allows the researcher to examine *how* and *why* questions. The *how* questions are useful for identifying the processes that a people under study use in order to accomplish objectives; whereas, the *why* questions are important for understanding the reasoning and purposes behind the processes (Yin, 2008). To investigate how and why questions, case study design encourages the inclusion of multiple data sources. Yin outlines the four design issues that a researcher must address when using case study design: (1) identify the unit of analysis; (2) decide whether the research calls for a single case or multiple cases; (3) enumerate

the case selection criteria; and (4) select multiple data collection methods. In Table 3, I explain how this dissertation's research design addresses each of Yin's four design issues.

Table 3

Addressing the Case Study Research Design Issues

Case Study Design Issue	Dissertation Research Design
1) Identifying the unit of analysis	1) The unit of analysis is computer use in Bangalore's fifth grade classrooms
2) Decide on single case or multiple cases	2) The dissertation investigates the unit analysis using multiple cases
3) Enumerate case selection criteria	3) Selection criteria included: (a) location; (b) access to computer technology; (c) SES variance
4) Data collection methods	4) The dissertation includes methods like questionnaires, interviews, and field notes

As Table 3 shows, I carefully crafted the dissertation's research design by taking into consideration case study design issues. Because of its insistence on multiple data sources, case study research design provides a robust data set that is useful for testing and developing theory (Yin, 2008). Although this dissertation starts with SCOT as the study's theoretical and methodological framework, each case study offers a descriptive and analytical lens for understanding (and, perhaps, building on) SCOT theory. In this study, I pair the SCOT theory with case study research design in order to examine the dissertation's primary research questions: (a) How and why is computer technology socially constructed in Bangalore's elementary schools? (b) How does the social construction of technology compare across schools? As I introduced in the dissertation's first chapter, I parsed the main research questions into four researchable sub-questions grounded in the SCOT methodological approach. From

October 2010 to May 2011, I investigated these research sub-questions using a qualitative research approach in the ethnographic tradition.

Data sources. I collected four sources of data: artifacts, field observations, interviews, and questionnaires. I start this section by describing the questionnaires. Identifying participants' demographics is part of the first step of SCOT. To fulfill this step, I collected demographic data, which included descriptive statistics, from the student questionnaire (see Appendix D) and a teacher questionnaire (see Appendix E). The first part of the questionnaire's purpose was to generate demographic data to answer the dissertation's first sub-question. So I designed each questionnaire to uncover contextual factors, like socio-economic status (SES) and experience that could be explained using descriptive statistics. For example, student questionnaire included questions about what type of energy source the child's family uses for cooking (e.g., firewood, cooking gas, etc.), home computer ownership, and how many books the child owns. In crafting the demographic related questions for the student questionnaire, I relied heavily on the Indian Government's Student Learning Study (RTE, 2010).

The teacher questionnaire's categories of demographic data included items such as: age, gender, and years of teaching experience. I also included questions to help identify each teacher's weekly access to computers at school and whether the teacher had access to a home computer. I report these demographic data in my description of each school. Additionally, these data provided additional context for understanding each school's relevant social groups (i.e., fifth grade students and teachers). Similarly, the questionnaires' data shed light on the predominant technological frame that defined each school. Technological frame is an important concept related to SCOT theory; it is a concept rooted in the notion that context, including political, cultural, and socio-economic factors, shapes the interpretations that each relevant social group

has regarding technology. Thus, I examined the demographic data from the questionnaires to help answer the fourth research sub-question related to each school's technological frame.

Additionally, I designed the questionnaires as a data source for the identification of each group's interpretative flexibility. In other words, the questionnaires included questions related to purposes for using computer technology. I crafted these questions to investigate the second research sub-question about the meanings that the relevant social groups assign to technology. The questionnaires also provided a way to triangulate data about each relevant group's perceptions and purposes for computer use at school. Specifically, the second part of both questionnaires included multiple choice question items related to purposes for computer technology use at school as well as attitudes about computer technology. I adapted Veriki's (2010) computer perception questionnaire in designing the questionnaires' second part. Additionally, the second part of the teacher questionnaire was adapted from Law, Pelgrum, and Plomp's (2008) research design for the Second Information Technology in Education Study.

I submitted the teacher questionnaire to all the teacher participants (n=12) and all the teacher participants returned their completed questionnaire for a 100% response rate. Likewise, I distributed the student questionnaire to all the study's student participants (n= 237). At Aadu International, 65 of the 66 students completed the questionnaire for a 98% response rate. At Bara National, 104 of the 110 students completed the questionnaire for a 94% response rate. At Komu Community, 48 of the 50 students completed the questionnaire for a 98% response rate. And at Jinka Public, all 11 students completed the questionnaire for a 100% response rate.

Field notes from on-site observations were largest source of qualitative data for answering the dissertation's research questions. I logged over 208 hours in the field. I averaged 48 hours of field observation time at each school and conducted 16 hours of interviews. To help

focus my field observations, I used the study's observation protocol (see Appendix A). I divided the protocol into the following four sections: (1) computer equipment; (2) computer usage; (3) time; and (4) student and teacher interaction. During each on-site visit, I would write or type the field notes according to the observation protocol for that day. I used time notations to help keep track of progression of each class I observed. Additionally, in my field notes, I tried to capture the actual dialogue among the teachers and students. At the Jinka Public school, though, I relied on two interpreters, both of whom I discuss more about later in this chapter, to aid in translating the dialogue among the school's teachers and students.

Interviews were a third data source. I conducted two kinds of interviews: individual educator interviews and student focus group interviews. At each school I interviewed a group of students. Although I designed the study to only include a group of five to seven students for the student group interviews, I found that I had to stay flexible about the student group interviews. For example, at Jinka Public, the teachers requested that I include all the fifth grade students in the student focus group interview. Overall, each school's student focus group interview had at least six students represented. While my intent was to select randomly the student focus group participants this was not always feasible. For example, at Bara National, there was likely a selection bias as the computer science teacher assigned me a focus group of students who finished a project early. At Aadu International and Komu Community, I was able randomly select students for the focus group interviews. I used a "semi-structured" interview technique (Miles & Huberman, 1994) based on interview questions (see Appendix B) that I prepared in advance of the study. I report the students' responses with the generic pseudonyms, like "student" and "students," in order to protect the identity the student participant. The average time length for each student focus group interview was 20 minutes.

I also interviewed all the educators (n=15) in this study. I designed the educator interview questions (see Appendix C) to ascertain similar information as the student interviews. However, during the educator interviews I also asked questions from my field note observations. Additionally, if I was interviewing the school's administrator, I would ask questions about the school's mission in relationship to the computer use. With the consent and permission from each educator, I audio recorded each interview. Additionally, I transcribed the interviews, but used only pseudonyms to protect the educator's identity. Each educator interview averaged over 45 minutes in length. In sum, I captured almost 15 hours of educator interviews. Combined, the student focus group interviews and educator interviews added 16 hours to the field time.

Artifacts were the fourth source of qualitative data. I collected artifacts from each school: curriculum documents, PowerPoint presentations, student created documents, and digital images of each school. I requested curriculum documents from each participating school, but Bara National was the only school that gave me their written computer science related curriculum document. While not a curriculum document, the fifth grade information and communication technology (ICT) teacher at Aadu International gave me a link to a wiki that she uses as a supplemental resource for her students. Additionally, the Aadu International teachers shared ICT training documents related to a professional development that they received on using their classroom Smartboards. All the study's teachers provided examples of student work, which included documents created with word processing software and presentations. Additionally, I captured over 300 digital images (see Appendix F for the protocol related to capturing digital images). The images provided a visual reference for comparing the computer hardware and material resources, including the classroom layout, at each school. The artifacts provided an additional data source to triangulate findings related to the SCOT based research questions.

Data Analysis

Consistent with the case study research design, the data collection and data analysis were often intermingled and occurred in concert with the other (Yin, 2008). The bi-weekly research memos that I would write to my dissertation director were part of this simultaneous act of data collection and data analysis. In these memos and during our monthly Skype meetings, I would map the data on to the SCOT theory components. I analyzed the demographic data, as reported on the student questionnaire and teacher questionnaire, using descriptive statistics. Descriptive statistics provide "snapshot" summaries of the participant's demographics as well as their interpretations of main purposes for computer technology. Since case study method relies on multiple data sources, it is known as a triangulated research design (Yin, 2008). Triangulation means the checking findings with at lease three data sources. The descriptive level data analysis provided another check on the data. Using descriptive statistics, I was able to triangulate findings about each relevant social group's interpretative flexibility and technological frame. However, these data provided only basic descriptive statistics and were not used to make claims toward causality or effects.

The other questionnaire data (as well as the artifacts, field notes, interviews) contributed to the "thick description" that defines each case study. I analyzed these data using the constant-comparative method (Glaser & Strauss, 1967) along with Miles and Huberman's (1994) three part interpretive approach: (1) data reduction; (2) data display; and (3) conclusion drawing through triangulation verification. The first part of this analysis, data reduction, meant reading the totality of each school's data. I read through all the field notes, interview transcriptions, and collected artifacts. I then re-read each school's data and continue data reduction through coding the data. There were codes, like SE for "school ethos," that I arrived at before this present study. School ethos (SE) and future preparation (FP) were codes from an earlier pilot study that I

conducted at a primary school in Southwest England. In that pilot study, I found both relevant social groups (i.e., teachers and students) in a sixth grade classroom perceived that computer technology was preparation for future success in school and in life. Additionally, I found how the teachers would refer to and emphasize the school's motto, "Connected to the Future," when discussing the purpose's for computer use. Thus, before this present study, I anticipated that school ethos and future preparation were two potential themes, and thereby would become codes. In my field notes, I included the school's mission statement and made note of slogans, posters, and signs that contributed to school ethos.

The second part of the qualitative analysis was creating data displays. For the data displays, I designed tables organized by the four SCOT categories: relevant social groups, interpretative flexibility, stabilization, and technological frame. The data display also allowed me to compare, contrast, include quotes, and probe additional themes (Miles & Huberman, 1994). The third step in my data analysis was to draw conclusions based on confirming evidence and data triangulation. Drawing conclusions is an inductive process of identifying themes that emerged from the data. Miles and Huberman (1994) explain that the data displays are what a researcher uses to begin to draw conclusions. Conclusion drawing, though, is also about describing how and why the purposes for computer use (i.e., the social construction of technology) made sense to the study's participants. Rereading transcripts and re-listening to the interviews proved to be helpful in further identifying the "sense making" of the participants.

Limitations of the Study

In any research project, especially one that is driven by interpretation of largely qualitative data, the researcher embodies the strengths and weaknesses of the research design (Gall, Gall, & Borg, 2007). The interpretations of a researcher shroud all the research stages; so

much so that the researcher, whether acknowledged or muted, holds "interpretive omnipotence" (Van Maanen, 1988, p. 53) over the entire research project. As Van Maanen reminds field researchers, such omnipotence is rife with limitations. How does the researcher recognize and make these biases transparent? Geertz (1992) recommends the researcher practice a certain amount candor and share "open and direct acknowledgement of limits" (p. 132). Peshkin (1988) reminds his audience that a researcher's subjectivity or bias can be uncovered; he argues that subjectivity is an "amalgam of the persuasions that stem from a person's background, status, class, and values" (p. 17). Rather than just being aware of subjectivity, Peshkin believes that researchers should systemically and actively seek it out.

Throughout the rest of this section, I share about my biases and background. I do so with the clear objective that the sharing reflects more of an exercise in self-acknowledgement rather than an exercise in self-absorption or what Van Maanen would call a "confessional tale" (p. 73). Related to my interpretations of this current study, I think is important to acknowledge that I am a Caucasian male, who comes from a middle class background as represented in the United States of America. I also acknowledge that I have a bias in favor of educational technology. As a user of technology and as a teacher educator who integrates educational technology in his classroom, I often advocate for the benefits of educational technology. I also privilege the use of computer technology in elementary schools as having powerful pedagogical potential and reality for the future. I am also privy to what Van Maanen (2002) calls the "unremarkable becomes under-represented" (p. 113), which means there a certain things happening in elementary school classrooms, like morning routines or lining up for recess, that I find rather ordinary so I do not make note of it. Thus, I have a bias in what I observe and, thereby, report. These biases are part of the study's limitations.

Language and translation. In preparing for this study, I did not give much thought to language. In three of the four schools, English was the medium of instruction so I naively thought I could easily train my ear to an Indian way of speaking English. Part of this thinking was based on the knowledge that I had visited India before and have had thousands of conversations with Indian speakers of English. I did find, however, that it took me longer than I would have expected to understand all the communication that was happening during my field visits. While I picked up the vocabulary quite readily, gestures and repeated phrases, like "do you have any doubts?" took me longer to comprehend. Wiggling one's head to signify "yes" or an affirmative response is a common facial gesture in India. It is easy to mistake a head wiggle for a head shake, which in another context, means "no" or is a negative response to a question. While I knew and had encountered the head wiggle gesture numerous times before conducting this research, I found it was a gesture I had to pay close attention to during the interviews.

Jinka Public was the only study site that required translation. While the Jinka Public teachers could converse in English, it was their third language, after Kannada and Hindi. The Jinka Public students were still developing their English language learning. As part of the study's research design, I translated the questionnaires and interviewing protocol into the Kannada language. I offered the teacher and student participants the choice between completing the English version of the questionnaire or the Kannada questionnaire version. The teachers chose the English version and the students chose the Kannada version. I also followed Emmel's (1998) suggestions for having two translators present in the field. The translators worked in tandem to agree upon the most accurate translation of what was said. Likewise, when I transcribed the interviews with the Jinka Public teachers and student focus group, I had Shalini, my wife, who speaks Kannada, double check the accuracy of each translation.

From a broader perspective, language and how it is communicated are representations of power (Bourdieu & Passeron, 1990). This is especially true in India, a multilingual society, where language is deeply connected with a person's identity. As examples, a person who speaks Kannada is known as a Kannadiga; a Tamil speaking person, a Tamilian; both are common terms of identification. The English language, British English to be exact, with its imposing history and colonial legacy in India, communicates all sorts of politics including: domination over rituals, global marketplace opportunities, and a language shift that has the potential to disintegrate culture and community (Advani, 2010; Dalrymple, 2009; Tharoor, 2007).

As an English speaker, albeit with an "American" accent, I embody the aforementioned politics the minute I open my mouth to speak or interview. Thus, the process of interviewing had limitations. Reflexivity is the notion that interview participants parrot back what they believe the interviewer hopes to hear. Even though I prefaced each interview with an acknowledgment that "there were no right or wrong answers, I just want to hear your thoughts on a couple of questions," it is possible that the interviewees may have only expressed what they thought I wanted to hear. Potential language bias in my syntax or wording of questions could have led participants to certain responses. I have no evidence for this and tried to design the interview questions to guard against reflexivity, but it is still a possibility.

Outline of Case Study Chapters

In this final section, I explain the ways that I have organized the dissertation's next four case study chapters. Each case study presents a story or what Van Maanen (1988) might call an "impressionist tale" of the ways that fifth grade teachers and students use computer technology. I begin each chapter with a short introduction about the school. After that introduction, I move into a description of the first main chapter section: social context and relevant social groups. I

spend a good deal of time in this section unpacking the social context in order to render a thorough description of the school (Maxwell, 2002). I narrate this contextual description in the present tense to draw the reader into the school's context, which as Van Maanen (1988) asserts is how "to crack up open a context. . . and present the doing of fieldwork rather than the done" (p. 102). In cracking open each school's context, I describe the classroom spaces, computer related curriculum, and the demographic characteristics of the students and teachers.

In each chapter's second section, I discuss the interpretations for computer technology. While these interpretations largely are derived from an analysis of the interview and questionnaire data, I start the section by sharing two small, but specific "impressionist tales" (Van Maanen, 1988, p. 101) that are a retelling of actual events that happened in the field with my interpretation of what transpired. Since these "impressionist tales" are short, I call them "snapshots." Like the social context description, I write these snapshots in the present tense to invite the reader into each snapshot and observe what I observed (Van Maanen, 1988).

In the third chapter section, I discuss how the technology in the case study school became stabilized by the students and teachers. I also introduce and explain the role that "accessory social groups" played in stabilizes the technology. The fourth section of each chapter is about the school's technological frame. The section will summarize how the school's social context, social groups, interpretative flexibility, and stabilization are all part of the school's larger technological frame. The technological frame is the ensemble of social-contextual characteristics that define that setting. SCOT theory posits that the technological frame becomes an interpretive lens that informs the meanings and negotiations among the social groups in that setting (Bijker, 1995). So I conclude each case study with an examination of the technological frame in order to summarize the case study's findings.

CHAPTER 4

FINDINGS: BARA NATIONAL SCHOOL

"COMPUTERS FOR LOGIC AND CODING"

In this chapter, I discuss Bara National School, which is a large private school that, perhaps, most closely captures the Bangalore Challenge. The school is nestled in a middle class neighborhood where many homes have at least a one car garage or a covered car port for parking their vehicles. Stores like Baskin-Robbins, Levi's, and Coffee Day (India's version of Starbucks) are located a couple of blocks from the school. These stores are reminders of how globalization continues to define Bangalore. The constant traffic around these stores is indicative of Bangalore's congestion. Since it is located close to downtown Bangalore, parking around Bara National School is at a premium. Small, sensible cars like Tata Indigos and Maruti Swifts crowd the available parking spaces along the perimeter of the school. Many of the cars have bumper stickers that divulge the middle class environs that surround the school. For example, one car's back bumper sticker states: *It is not what you drive, it is where you park.* Although it might seem trivial, Bara National School was the only school in the study where the vehicles parked around the school had bumper stickers. These bumper stickers seemed to represent middle class sound bites.

Social Context and Relevant Social Groups

Slogans, like the ones found on car bumpers, often communicate an interpretation about life or society. At Bara National there were several slogans and motivational type posters that revealed the identity of the school. For example, on my first observation day at Bara National, I took note of a framed poster near the school's main computer lab that stated, "The way to get noticed is to do QUALITY work." The word quality was typed in all capitals on this particular

poster. The poster seemed to serve not only as a marker of pithy advice, but also as an important reminder to Bara National's students: quality work is a key to success. I also noticed what the poster did *not* say. For example, it did not say, "The way to get noticed is to be creative" nor did it state something even more obvious, "The way to get noticed is to ask questions." On the contrary, this poster, as well as the many other slogans fastened to the walls and bulletin boards of Bara National, emphasized the importance of work in relationship to distinction. These slogans helped to shape the school's context.

School and schedule description. Bara National School is housed in an immense five story school building that covers the area of an entire Bangalore city block. The school is painted white and is surrounded by a high concrete wall that has three gated entrances. Bara National goes from prekindergarten to twelfth grade and serves over a 1,000 students. The school's curriculum and schedule are academically rigorous. The school day begins at 8:15 in the morning with the student body gathering in the large dirt courtyard behind the school. The morning routine includes a recitation of a pledge to the Indian flag and the singing of the Bara National anthem. On some mornings, students also complete stretching and yoga type exercises. An 8:25am bell signals to the Bara National students that it is time to quickly disperse from the courtyard in order to arrive to their first period class by 8:30am. Not counting lunch and a short break of 15 minutes, the students have eight class periods of 45 minutes each. The students are dismissed around 3:30pm each day. Certain times throughout the year, usually coinciding with a comprehensive examination period, the Bara National students also attend school on Saturdays for about three to four hours.

All fifth grade students start their day with mathematics. Three days a week, the fifth graders have an additional mathematics period; so on those days the students have 90 minutes

total of math. Over the course of a fifth grade student's weekly schedule, mathematics accounts for 20% of the time. The students also have six 45 minute periods of science during a regular school week. Together, mathematics and science comprise more than one-third (35%) of the class time in fifth grader's weekly schedule. English is another subject that is scheduled six times during the week and like science, comprises 15% of weekly schedule. One day a week, English is scheduled for two time periods, so that the students have 90 minutes of English that day. In addition to English, mathematics, and science, the fifth grade students also have Hindi, Sanskrit, and social studies as part of their daily schedule. The fifth graders' weekly schedule is rounded out with special subjects like: art, computer science, dance, library, physical education, singing, and yoga. Computer technology is not integrated into the Bara National general curriculum. Rather, the fifth grade students have a specific computer science class period where they meet once a week.

Classrooms and computer lab description. The fifth grade students are divided into three sections. Each section has its own homeroom where students spend the majority of their academic day. The homerooms are compact, cubed shaped rooms that are plain but spotless. Each homeroom has several large windows that are encased with iron security bars. Except during the monsoon months of June through August, the windows remain open. In each homeroom, a large ceiling fan helps to circulate Bangalore's humid, tropical air. Each homeroom's focal point is the teacher's lectern and the slate chalkboard. Students squeeze into bench style, mahogany desks that are tightly arranged in three rows of six. The homeroom teacher assigns students to their places on the bench, which remains the seating arrangement throughout the year.

The homerooms are not equipped with computer equipment or digital devices like an LCD projector. Each homeroom, though, has a small bookcase for a class library and for storing textbooks. Student projects, like handwritten reports on India's tigers, are showcased on the top of the bookcase. A large bulletin board hangs on a wall in each homeroom. Announcements about upcoming tests and comprehensive exams are prominently displayed in the middle of the bulletin board. The weekly schedule is also posted as well as a collection of quotes and slogans. Example slogans include: (a) "If there is no struggle, there is no progress." (b) "The student who is never required to do what he cannot do, never does what he can do." (c) "It is greater work to educate a child than to rule a state." (d) "When pain ends, gain ends too."

There are four rooms at Bara National School equipped with computer technology. These rooms are: the school library, the audio-visual (AV) room, and the school's two large computer labs. I spent the bulk of my field observations at Bara National in the school's main computer lab and in the AV classroom. The students use the school's computer labs exclusively for their computer science classroom period. Students go to the AV classroom for what the computer science teachers call "theory work," which is when the teachers introduce and demonstrate computer applications that the students will later practice. The students use the school's computer labs exclusively for their computer science classroom period. The "main" computer lab gets the most use. The main lab is spacious, uncluttered, and well lit. Five ceiling fans circulate the air in this breezy space. There are 45 Dell LCD, 19 inch, flat screen monitors in the main computer lab. Each monitor sits on a learning station desk, which includes a roll-out drawer for the keyboard and mouse. The monitors are cable connected to a mainframe computer located in the adjacent classroom. Behind each learning station is a bright red plastic chair.

Four emerald colored bulletin boards hang on an interior wall of the main lab. The Bara National secondary students are responsible for decorating the bulletin boards with different technology related themes. For example, the boards have collages of computer related icons, like the Microsoft Windows logo and the Apple logo. Mathematics and science related images (i.e., pie charts, graphs, pi signs, and outer space) are included on the bulletin board collages. Adorning the border of each bulletin board are technology related quotes like: (a) "Computer comes from the title of a mathematician's apprentice; the apprentice was responsible for computing numerical calculations." (b) "To err is human, to really foul things up requires a computer." from *The Farmer's Almanac 1978* (c) "Each copy of Microsoft Window's 2000 contains 60 million line of computer code." (d) "More than 80% of all the information on the World Wide Web is in the English language." The quotes are playful and poignant. They are slogans that communicate various interpretations about the school's computer technology.

The curriculum. Bara National is an English medium school. All subjects, except for Hindi and Sanskrit, are taught in the English language. The school is affiliated to the Central Board of Secondary Education (CBSE). At the elementary level, the CBSE designated Bara National with "autonomous status," which means the school is allowed to craft its own elementary school curricula. The computer science curriculum was designed by a team of 10 computer science teachers who are from Bara National and two of Bara's sister schools in Bangalore. I refer to this team as the Bara Computer Science Team. The team uses what I would call a "backward planning design" (Wiggins & McTighe, 2005) in crafting the curriculum. The scope and sequence of the elementary school computer science curriculum, as displayed in Table 4, prepares students to become familiar with the keyboard and to master the functions of different software.

Table 4

The Elementary Computer Science Curriculum at Bara National

Grade Level	Topic and Skills	Software
First Grade	Introduction to the computer Use the mouse, keyboard, arrow keys, and how to type	Picture maker (Students use the arrow keys to make simple pictures)
Second Grade	Introduction to the computer's logic Create pictures and draw with TuxPaint	TuxPaint (Free and Open Source Software –FOSS)
Third Grade	Recognize the Input-Process-Output cycle Create images with Microsoft Paint Practice the LOGO computer language	Microsoft Paint LOGO
Fourth Grade	Identify an operating system (OS) and network Use command keys in MS LOGO Draw geometric figures with MS LOGO	E-mail DOS Microsoft LOGO
Fifth Grade	Comprehend and utilize word processing feature Create a PowerPoint and use images to enhance PowerPoint presentations	Microsoft Word Microsoft PowerPoint
Sixth Grade	Create a simple HTML webpage Introduce the Internet Create and enter data on a spreadsheet Perform basic math operations on a spreadsheet	Internet Explorer HTML programming Microsoft Excel

As Table 4 shows, the Bara National computer science curriculum is quite comprehensive. The computer science teachers stress the importance of teaching the children to become familiar with the "entire keyboard." The Bara Computer Science Team designed the curriculum not only to introduce students to various software programs (i.e., Microsoft Word), but to also introduce and provide the students lots of opportunities to use all the keyboard commands. The head computer

science teacher, Ms. Janisha, explained how knowing "the entire keyboard" was an essential part of learning to program. By the time the Bara National students matriculate to the seventh grade they have a solid foundation for programming in Visual Basic.

On my first observation day at Bara National, Ms. Janisha presented me with a 20 page document of the school's scope and sequence. Additionally, the fifth grade computer science teachers gave me the fifth grade's "notebook manual," which contained all the fifth graders' computer science lessons and activities. The notebook was more than 80 pages long and the students used this notebook like a text book. The notebook provided detailed information about Microsoft Word and Microsoft PowerPoint, the two programs that the fifth graders learned throughout the year. While the students were encouraged to use a home computer for projects in science and social studies, the computer science teachers reported that it was rare for the fifth grade students to use the Bara National computer labs for any other subject matter besides computer science. Hence, there was very little integration of computer technology throughout the fifth grade core curriculum.

The computer science teachers. All of Bara National School's computer science teachers are female. The computer science teachers always come to school professionally dressed in either a traditional *sari* or a *salwar kameez* with a *dupatta,* which is a long shawl. Two of the computer science teachers, Ms. Sanchana and Ms. Vitna, are responsible for the instruction of the school's fifth graders. Ms. Sanchana is the longer tenured teacher of the two. She has been teaching at Bara National for over 10 years and has a Master's in computer science. Ms. Vitna has a Bachelor's in computer science and was in her sixth year of teaching. For this study, I also interviewed Ms. Janisha, the head computer science teacher. Although Ms. Janisha is not directly involved with the fifth grader's computer science instruction, she oversees the

school's entire curriculum design and implementation. Ms. Janisha has been teaching at Bara National School for over 20 years. She has a dual Master's degree in computer science and education. On the teacher questionnaire, all three teachers indicated that they all owned a home computer and revealed that lesson planning was their primary use of their home computer.

The fifth grade students. There are 110 fifth graders at Bara National. Of those 110 students, 104 of them completed the student questionnaire for a 94% return rate. Four students were absent the day the questionnaire was distributed and two students elected not to complete the questionnaire. As mentioned earlier, the fifth grade class is divided into three sections. One section has 36 students while the other two sections have 37 students each. The gender pairing is almost equal as boys make up 52% of the fifth grade class. Students wear uniforms that are neat, clean, and business like. The boys wear dark dress shoes that shine with polish, brown pants with a black belt, and a pin-striped, short sleeve dress shirt with a red tie. The girls also wear the same shirt with a tie as well as a brown skirt and polished dress shoes. While school uniforms are common throughout Indian private schools, the Bara National uniform made the students look like they were professionally trained learners.

All the fifth graders who completed the student questionnaire indicated that their family owned a cell phone and a television. Ninety-eight percent of the families own a home computer. All the fifth graders indicated that their families cook meals on a kerosene stove or with a hot plate connected to a cooking gas cylinder. For transportation, all the students indicated that their family owns a car and 88% of Bara National families also own a bicycle. More than three-quarters of the students reported having over 100 books in their home. Most of the fifth graders live in a home or flat (i.e., apartment) with five or six rooms, including a kitchen and one bathroom. The students at Bara National are squarely in India's middle class.

Interpretative Flexibility

As discussed in Chapter 1, SCOT theory employs the term interpretative flexibility to recognize that relevant social groups' have different interpretations for computer technology. However, as the social groups interact and negotiate meaning (which SCOT refers to as stabilization) interpretative flexibility diminishes as the social groups agree on a unitary meaning for the technology. I posit this meaning to be unitary, as opposed to a singular meaning, because of the multiple interpretations, albeit related, that share space in the meaning. The section's header is something of a misnomer, while I do touch on the interpretative flexibility of the Bara National computer science teachers and fifth graders; the section is more about the unitary meaning for the school's computer technology. I start by sharing two "snapshot" examples how the fifth grade students use the school's computer lab.

Creating a textbox. Upon earlier directions from Ms. Vitna, a fifth grade section gathers in their homeroom for the start of the computer science class period. The fifth grade students, all 37 of them, are sitting shoulder to shoulder behind their bench style desks. Ms. Vitna enters the classroom. The students all rise and say, in unison, 'Good morning, ma'am." Ms. Vitna points to where I am standing and says, "Sir is here again." Then the fifth grade students turn to me and say, "Good morning, sir." I reply with, "Thank you, good morning." Then Ms. Vitna motions for the students to be seated. Ms. Vitna writes the word "textbox" on the classroom chalkboard. She turns to the students, who are all silent, and states, "The lesson for today is how to create a text box (in Microsoft Word)." She then asks the students, "Children, tell me, what is the lesson for today?" The students eagerly respond, "Ma'am, the lesson for today is how to create a textbox."

Ms. Vitna continues, “Who here knows what a textbox is?” Several students raise their hands and begin shouting, “Ma’am, ma’am, pick me, ma’am!” Ms. Vitna chooses a boy in the front of the classroom. The boy stands up and promptly replies, “Ma’am, a textbox is a box in Word that you can make to insert text, ma’am.” Ms. Vitna smiles at the boy. The boy sits down. Ms. Vitna goes back to the chalkboard and creates a flowchart below the word “textbox.” She uses arrows and words to create the flow. She writes, with chalk, the following words: insert, textbox, right button, add text, and edit text. Ms. Vitna draws an arrow between each word. The arrow is pointing down. Then Ms. Vitna explains that she is going to teach everyone the five steps to create a textbox.

Ms. Vitna starts, “To make a textbox, you click on the insert tab, then you click on textbox, then you use your mouse’s right button to place the text box on the document. From there you can add and edit text.” Ms. Vitna pauses, scans the classroom, and states, “If you have any doubts, then please raise your hand.” The students remain quiet and no one raises a hand. Ms. Vitna replies, “Good, now we go to the AV room to see how to create a textbox. Children, now line up and go to the AV room.” The girls line up and go first, the boys then line up and follow Ms. Vitna to AV room. It takes the whole class less than 45 seconds to climb a flight of stairs and find their seats in the AV room.

The AV room’s desktop computer and PowerPoint projector are already on. Ms. Vitna opens a new document in Microsoft Word and asks, “Children, who here remembers the steps for creating a textbox.” Hands start waving and Ms. Vitna chooses a boy to answer. The boy stands up and explains, “Ma’am, first you click the insert button, then you go down and click where it says textbox, ma’am.”

Ms. Vitna follows the boy's directions and the boy resumes his instructions, "Ma'am, now you place your text box on the document and add your text, ma'am." The rest of the students watch as Ms. Vitna inserts the text book. Ms. Vitna tells the boy to sit down and then asks the entire class, "Do you have any doubts?" This time the students all reply (in unison), "No, ma'am." Ms. Vitna informs them that they are now going to walk to the main computer lab where they are to do the following six things: (1) Insert at textbox; (2) Type something in the textbox; (3) Resize the textbox; (4) Highlight the textbook in a different color; (5) Create a border around the textbox; (6) Save the work to the fifth grade class folder. In all, the demonstration in the AV room lasts only six minutes.

The students walk to the main computer lab, sit in their assigned spots, and open a new Word document. They have about 20 minutes to complete the textbox tasks. Ms. Vitna enters the lab and inquires, "Children, okay, children what six things are you to do?" Hands go up and students are eager to answer. Ms. Vitna selects a girl. The girl stands up and says, "Ma'am, you want us to insert a textbox, type something inside it, resize the textbox, color it, make a line around it, and then you want us to save it to our folder, ma'am." Ms. Vitna tells the girl that she remembered correctly and could sit down. During the next 20 minutes, the fifth graders complete the six textbox tasks. Ms. Vitna circulates around the main computer lab room and checks the students' progress. A bell rings; the students push in the keyboard drawer, stand behind their red plastic chairs, and wait to be dismissed by Ms. Vitna. After all the students are standing up with their chairs pushed in, Ms. Vitna says, "Children, you may go." With that the students are off to their next class period.

Analysis of creating a textbox. This snapshot captures a typical computer science lesson at Bara National, in terms of pedagogy and organization. So what does the snapshot tell? There

are two details that I highlight. The first detail is Ms. Vitna's authority as the computer science teacher. Throughout the lesson, Ms. Vitna is the focus. The students listen and do not question her authority or her knowledge of what their learning to do with Microsoft Word. The compliance of the students is an important part of the computer technology's stabilization, which I will discuss later in this chapter. However, just a couple of observations related to student compliance. I observed over 50 hours of computer science class periods at Bara National and never heard a student ask Ms. Vitna (or Ms. Sanchana or any other teacher for that matter) questions like: Why do I have to do this? Why are we learning this? How will this help us in the future? In fact, in all my observation hours at Bara National, there were only two times when students raised questions after the computer science teachers asked, "Do you have any doubts?" In both instances, the students responded with a clarifying question rather than a question of resistance. There is a high degree of deference and authority conferred on the computer science teachers.

The second detail relates to Ms. Vitna's orderly pedagogy. Ms. Vitna organized this textbox lesson into a series of linear steps. This was not by accident. Rather, Ms. Vitna was modeling the logic that a computer uses to process commands. Indeed, Ms. Vitna's lesson demonstrated a key technological (and pedagogical) interpretation that the entire computer science team assigns to the school's computer technology: computers are logic devices and students should learn to operate the computer in logical steps. For example, by the end of her lesson, Ms. Vitna expects her students to complete the same sequence or steps for creating a textbox. The steps are more than just a list of directions; the steps are a way for the students to develop their understanding of the computer's logic.

A practical test. Another time I observe a fifth grade section complete what the computer science teachers call "a practical test." Every three weeks the computer science teachers assign a practical test where the students demonstrate the skills they have mastered from the previous class periods. As Table 5 shows, the purpose of the practical test was for students to demonstrate that they knew how to underline, create a bullet point list, and change the font size and text color in Microsoft Word.

Table 5

Two Versions of a Fifth Grade Practical Test for Computer Science Class

Computer Science Practical Test – Code A	Computer Science Practical Test – Code B
Duration: 30 minutes Max Marks: 25	Duration: 30 minutes Max Marks: 25
Instructions: I. Design a MS Word document as given below: a. For the Heading, set any Font name (type), Font Size=22 b. Underline the heading c. Bullet the given list (Any bullet of your choice) d. Use any font color for the bulleted list	Instructions: I. Design a MS Word document as given below: a. For the Heading, set any Font name (type), Font Size=22 b. Underline the heading c. Bullet the given list (Any bullet of your choice) d. Use any font color for the bulleted list
II. Save the document as name.sem1.doc in 5 folder	II. Save the document as name.sem1.doc in 5 folder
Here is your heading: Peaks Here is the list: Mount Abu, Badrinath, Kapilash	Here is your heading: Temples Here is the list: Badrinath, Kedarnath, Lotus

Ms. Sanchana allots 30 minutes to complete the practical test. Most students, though, need less than 15 minutes to finish. During the practical test, the computer lab is silent save for students tapping on their keyboards. Ms. Sanchana walks around the classroom to check on the

students' progress. At one point during the practical test, she states, "If any of you have any doubts about the instructions, please raise your hand." Not a single hand goes into the air. After about 15 minutes, most students complete the practical. Ms. Sanchana tells the students who are finished to either Microsoft Paint or TuxPaint and create drawings for the rest of the class period. I observe that most of the fifth grade students open TuxPaint and create pictures using that program. I ask Ms. Sanchana about this and she explains that the children like TuxPaint because it was recently installed on the computers and allows students to create paintings. Then Ms. Sanchana added, "I don't mind that they play with it after they are finished. The children work hard in the regular classroom that they see the computer lab as a place where can have a break from the pressures of school."

Analysis of a practical test. This snapshot captures two more themes related to the unitary interpretation for Bara National's computer technology. First, the snapshot shows an example of the skill-based foci of the computer science curriculum. The fifth graders are assessed on their demonstration of computer skills rather than on the production of specific content. Indeed, the peaks and temples content on the direction sheet that Ms. Sanchana passed out were trivial. Ms. Sanchana's objective for the assessment was to identify if the students could create and format a bulleted list of information. The emphasis on practicing skills is another part of the computer science team's unitary meaning for the school's computers; which is to develop programming and coding skills.

The practical test snapshot also shows the testing culture that defines Bara National. The fifth graders take a practical test about every third class period, which means that 33% of their computer science curriculum involves summative assessments. Frequent assessment is a common practice throughout Bara National. Krishna Kumar (1991) explains that India's

"textbook culture" (p. 65), a culture instilled by England during India's colonial history, contributes to the practice of habitual testing. In a textbook culture, there is fixed knowledge and content based in a textbook that the student is required to reproduce (Kumar, 1991; Sarangapani, 2003). Tests and examinations are the most efficient way to evaluate whether a classroom crammed with students has learned the textbook's content. Therefore, the school's habit of testing reflects the Indian education system's socio-historical context.

Another part of the habitual testing seems more pragmatic: classroom management. Bara National's class sections average 36 students per section. In a classroom space the size of a large bedroom, the pedagogical options are more constrained so habitual testing helps ensure a class of students who are quiet, focused, and orderly. Testing is another interpretive feature for Bara National's computer use. The practical tests, as summative assessments, provide a way for the computer science teachers to monitor the students' development of logical skills as they learn to program software. In light of Bara National's habitual testing, focus on skill development, and didactic instruction, I found Ms. Sanchana's final comment about student enjoyment to be quite interesting. Ms. Sanchana shared how fifth graders interpreted the computer science period to be a "relaxing break" from their otherwise busy schedule. The interpretation of the computer science curriculum being relaxing was something that the participants echoed in their interviews.

Computer science teachers' interpretations. Even though I interviewed each computer science teacher separately, the three shared a similar interpretation regarding the computer science curriculum. In my analysis of the first snapshot, I explained how the computer science teachers identified the computer as tool for developing logic. Furthermore, the computer science teachers believed that logic was the foundation for computer coding and programming. This emphasis on logic and coding was repeated throughout their interviews.

I started each teacher interview with this question, "What two words or phrases do you think of when you hear the word computer?" While I asked this to the computer science teachers separately, I report their responses together. The computer science teachers replied with, "A wonderful, human invention," "computers are logic devices," "a machine used for trade and education," "research," "an appliance," and "enjoyment." The computer science teachers' responses suggest that they understand the computer to be a tool (i.e., device, machine, or appliance) that people use for many different purposes.

In answering my next question the computer science teachers began to narrow in on a unitary interpretation for the computer's primary purpose at Bara National School. I asked each computer science teacher, "What do you understand as the purpose of using school's computer technology?" The lead computer science teacher, Ms. Janisha, explained that the purpose of using computers in school was to "enhance a child's ability to think logically." Ms. Janisha also stressed that the Bara National computer science class provided a "reinforcement of the logic the children learn in mathematics and science." Ms. Janisha continued this thought by explaining, "At this school, we are not so much teaching the children about computer technology, because computers keep changing, what we teach them is logic, because a strong foundation in logic helps the children confidently use technology." The two fifth grade computer science teachers concurred. For example, Ms. Sanchana shared that the main purpose for the school computer was to "acquaint the children with the computer so that they can know how it works and, in the future, how to develop computer programs."

Developing logic was the computer science teachers' main interpretation for computer technology use. From their interviews and teacher questionnaire responses, the computer science teachers identified three criteria for the development of logic development. Confidence in using

all the keyboard commands was the first criterion for logic. The second criterion was continual practice using software applications and tools, like the formatting tools in Microsoft Word. The third criterion was framed as the outcome of logic development: students knowing how code and program software. Indeed, the overarching goal of the Bara National curriculum is for the students to learn several computer programming languages including Visual Basic and C++.

The computer science teachers use the phrase "not have any doubts" in relationship to the first criterion of developing confidence. To not have any doubts means two things. First, the phrase was an invitation to ask questions in order to eliminate any doubts about a certain skill. Second, the phrase is also used in a synonymous way with building skills. For example, I asked Ms. Vitna about why she had the students use keyboard commands in Word (i.e., Ctrl C for copy, Ctrl V for paste) rather than use the computer's mouse. Ms. Vitna replied with, "It is because I want the children to learn how to use the keyboard commands as well as the mouse. They need to know how to use all the keyboard, so that they will not have any doubts." In this sense, "not having any doubts" meant recognizing and deftly using all the keys on the computer's keyboard. Another phrase "all the keyboard" was also connected to developing confidence and the skill set needed for programming computer software. At Bara National, the computer science teachers start early, at the first grade level, teaching the students to confidently use the computer's keyboard and thereby eliminating "any doubts."

In her interview, Ms. Sanchana discussed confidence in relationship to the second criterion about practicing. Ms. Sanchana stated that while confidence is a great quality for fifth graders, students develop this confidence through the practice of skills. Ms. Janisha, the head computer science teacher, shared a similar interpretation when I asked her, "How do the students develop and grow in confidence?" Ms. Janisha explained, "The children develop confidence as

they practice using applications. This practice is the stepping stone for the programming language, like HTML and Visual Basic, which these fifth grade children learn when they progress to sixth and seventh grade." Ms. Janisha finished her response by surmising that confidence and practice are both parts in the "long journey to learning programming, learning to use the computer to solve simple problems, and learning to think logically." The journey is sustained, according to the Bara National computer science teachers, when the students have opportunity to practice skills. The commitment to practice was evident in the computer science teachers' time management. As part of my field observations, I kept track of the students' practice time. I found that for a 45 minute computer science class period about two-thirds of the time was for practice. As the first snapshot depicted, the computer science teachers directly instruct the students for about 15 minutes. The pace of their instruction is swift, exact, and with some degree of call and response, but no discussion. The remaining time, around 30 minutes, was for the students to practice.

Programming was the third criterion for learning to think logically. Programming is also the outcome of thinking logically. However, the computer science teachers were committed to a pedagogy that modeled programming type skills. Ms. Sanchana explained this pedagogy, "Programming requires attention to orderly steps and details. I divide all my lessons into five or six sequential steps that are easy for the children to remember." The idea here is that programming involves logical steps or commands for the computer to operate. Hence, the most efficient way to learn programming is through direct, sequence focused pedagogy (i.e., explaining things in logical steps). On the teacher questionnaire, I had the computer science teachers' rank five statements (from order of greatest importance to least importance) about computer related skills. Two computer science teachers ranked "program or coding computer

programs" as greatest. The third computer science teacher ranked "creating documents or multimedia presentations" as greatest, and second most important was "program or coding computer programs." I followed up with the computer science teachers about these rankings. I was interested to hear about why they thought programming was so important. In their responses, Ms. Sanchana and Ms. Vitna emphasized that programming is what the students will need to know how to do as they progress through Bara National. Ms. Janisha was more specific in her answer, "It is because over 80% of our graduates go into a computer related field in Bangalore, so we prepare them for their future work."

Students' interpretations. The Bara National students shared somewhat different interpretations for the school's computer technology. However, before I unpack the examples of the students' interpretative flexibility, I share details about their attitudes regarding computer technology. On the student questionnaire, all the students agreed or strongly agreed that they enjoyed using the school's computer technology. Additionally, all seven students in the student focus group agreed with what Ms. Sanchana shared at the end of the second snapshot. The student focus group reported that they enjoyed the computer science period because computer science was the class that connected to what they wanted to do for a career. All the students in the focus group agreed that computer science was nice break from their normal schedule.

My first interview question to the student focus group was the same as the teachers' interview, "What two words or phrases do you think of when you hear the word computer?" The students responded with the following associations: "games [repeated six times]," "entertainment [repeated five times]," "textbox," "searching," and "Internet." I then asked the students about what the computer helped them to do at school? While all the students answered this question, their responses were short and to the point. Three students shared that the computers helped

them to know how to create a textbox in Microsoft Word. I was not too surprised by this response since the students just finished a practical test about creating textboxes. Two students explained how the computers helped them to save files. Two other students shared how the computers helped them to create nice transitions and animations in Microsoft PowerPoint. All the students responded with skills they were learning in the computer science class.

In my data analysis, I noticed how the student focus group created a dichotomy regarding their interpretations for computer technology. When I personalized the questions by asking the students what they would prefer to do with computer technology or what words they associated with technology, then the students' responses were more about playing online games or using computer technology to access entertainment related websites like the Indian Premier Cricket League. However, any question that I contextualized by framing computer technology within the context of schooling, the focus group answered with references to specific skills they were learning in their computer science class. For example, I asked the focus group if what they were learning right now on the computers would be helpful in the future. All the students referenced specific skills that they were learning in Microsoft Word. One student shared that, "Yes, because in the future, if you don't know MS Word then you will be stuck. If a boss gives you a project or a presentation to prepare, knowing MS Word, will help you be able to complete it." Related to the future, another student also explained, "In the future I need to know how to make a textbox or use bullet points for work projects. We learn many things to help in the future."

The dichotomy was a representation of students' interpretative flexibility. The Bara National students had one set of interpretations regarding computer technology when it was related to the context of school, but quite a different set of interpretations outside of the Bara National context. The students' questionnaire responses also revealed the dichotomy of their

interpretative flexibility. For example, their responses to the question about what they believe to be the most important thing to do on a computer were quite mixed. Of the students who completed the questionnaire, 54% selected "search for information" as the computer's most important purpose, 38% selected playing games, and only 6% of the students selected "learn basic skills," which was the response that their computer science teachers selected the in response to the questionnaire item about the computer's most important purpose.

Finally, in general, I found that of all the dissertation's student focus groups, the Bara National focus group gave the shortest answers to my interview question with the least amount of explanation. This was not because the students were rude. Rather, it could have been a reflection of the respect they were showing me as an outsider and older, authority figure. It may have also been a reflection about the lack of experience they had with small group discussion. Or it could just be that the Bara National students were use to responding with short, direct answers to questions.

Summary. In sum, the Bara National teachers and their students had different interpretations for their schools' computer technology. For the Bara National teachers, the computer technology was about the development of logic and skills for coding and programming computer software. For the students, who dichotomized their interpretations, their interpretative flexibility was broader. The interpretations were related to the specific MS Word skills but also included searching for information and playing games, which were activities they did on their home computers. While the interpretative flexibility was different, the Bara National computer science teachers' interpretations for the school's computer technology dominated the meaning making for the school's technology. Indeed, as shown in the snapshot examples, the students complied with the computer science teachers' unitary interpretation for computer technology.

While the students' had different interpretations regarding the computer technology, they were strongly in agreement with their teachers that computer technology would be helpful in their future jobs and careers.

Stabilization

Stabilization is the negotiation process, among social groups, that leads to an agreement about the unitary meaning for the school's computer technology. When such an agreement happens, SCOT identifies that the technology's meaning becomes obdurate and fixed so that the meaning goes from flexibility to obduracy (i.e., becoming hardened) and adopted into the school's rhetoric and "network of practices" (Bijker, 1995, p. 273). At Bara National, the computer science teachers dominate the stabilization process with their interpretation for the school's computer technology as developing logic for computer programming. I use the word dominate in a descriptive way rather than in an evaluative or judgmental way.

The domination of the Bara National computer science teachers is a reflection of the hierarchical relationship of schooling. Kumar (2003) asserts that it is the nature of elementary schooling, especially elementary schooling in India, for a hierarchal relationship to exist among teachers and students; such a relationship maintains order. The teacher's position of authority over the students gives the teacher power over the students' decision making (Apple, 1995). The domination of the teacher is also a reflection of cultural norms in India, where children are taught from an early age the Hindi phrase, "*Mada, Pita, Guru, Daivam (*mother, father, teacher, god)" as the hierarchy of respect and importance.

Related to these cultural norms is the respect conferred because of a person's age. The Bara National students use the word "ma'am" as a sign of that respect. Ma'am is short for madam and it is quite common to hear students start and finish their sentences with "ma'am"

when they are addressing a female teacher. Sarangapani (2003) explains that the use of the word "ma'am" in Indian schools is also rooted in the cultural identity of the teacher being a *guru*. Sarangapani defines guru as a knowledgeable leader who has strong moral authority. Thus, ma'am is not only a term of reverence; ma'am is an acknowledgement of the teacher's wisdom and authority. Conversely, the hierarchal structure and cultural norms did not mean the computer science teachers were domineering. Quite the opposite actually, for example, the computer science teachers referred to their students using the endearing term, children. In the interviews, the computer science teachers spoke highly of the students' hard work and dedication.

The domination by the computer science teachers had to do with the curriculum they taught rather than how they taught it. Indeed, the scope and sequence of Bara National's computer science curriculum was oriented towards developing logic and skills necessary for programming. The school's computer science curriculum, which was developed by the Bara Computer Science Team, was part and parcel of the domination. The curriculum's focus is on understanding the logic of the computer's software. The computer science teachers' pedagogical practice is an extension of the curriculum as the teachers break down computer skills into small orderly steps in order to show students the computer's logic.

Stabilization is about power (Bijker, 1995; Giddens, 1979). Stabilization reveals the social group who had the power to dominate the meaning making of a technology. At one level, it is evident that the two fifth grade computer science teachers at Bara National had power because of their cultural position of authority. Yet, I contend that the computer science curriculum had a great deal of power in stabilizing the meaning for the school's computer technology. For example, the two Bara National fifth grade computer science teachers reported that they would not veer from the computer science curriculum at all

The Bara Computer Science Team was another social group that had power in stabilization process. Yet, the Bara Computer Science Team was not a relevant social group since the team had different degrees of proximity to the actual classroom uses for the technology. SCOT posits that there are secondary social groups that also influence a technology's social construction. SCOT labels these groups as "other social groups" (Bijker, 1995, p. 271). According to SCOT, other social groups have an indirect influence on a technology's social construction and have little inclusion into the uses for the technology. In expanding on SCOT theory, I contend that "other social groups" is a limited and problematic term when it comes to describing the social construction of technology in schools.

The limitation is that "other social groups" does not precisely represent the agency and power that some "other social groups" possess. I might be tempted to identify Bara Computer Science Team as an "other social group," but such a label does accurately represent how directly involved the Bara Computer Science Team is in shaping the school's curriculum. Indeed, the team has a high degree of influence in the stabilization process. Thus, a more refined term is needed to describe "other social groups" like the Bara Computer Science Team that have a great deal of influence in stabilizing the meanings assigned to a technology even if these groups have little inclusion in the actual daily classroom uses of the technology. I introduce "accessory social group" as terminology that more accurately depicts this relationship. I include the word "accessory" to illustrate how these social groups add their influence and take on a supplementary role (as opposed to a subordinate or "other" role) in a technology's social construction.

Accessory social groups. I define accessory social groups as social groups that have a high level of influence in shaping the meanings of a technology, but have a low level of inclusion into the technology's actual use. Figure 1 illustrates a graphic representation of my definition of

accessory social groups. The top arrow represents the high level of influence that accessory social groups have in shaping the meanings for computer technology, while the bottom arrow captures the low level of inclusion in the actual uses for the technology.

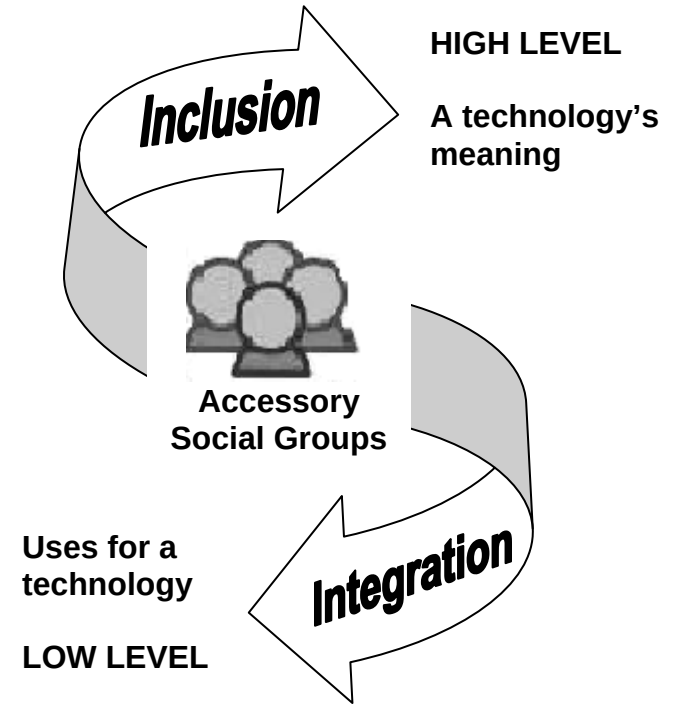

Figure 1. A graphic representation of the definition of accessory social groups.

Throughout the rest of the dissertation, I will reference Figure 1 as I develop the terminology's meaning in fuller detail. In identifying the study's accessory social groups, I adhere to Bijker's (1995) technique of "follow the actors" (p. 46). This technique or method involves listening carefully and noting any groups of actors that a relevant social group repeatedly refers to in their communications. For example, in my interviews and conversations with Bara National's computer science teachers, I observed the computer science teachers repeatedly talk about the Bara Computer Science Team. They talked about their "summer

break" planning meeting with this team, they talked about what it was like to collaborate with teachers from Bara National's sister schools, and they also talked about the review and approval process related to their work in the Bara Computer Science Team.

Yet, the computer science teachers also mentioned, a number of times, the Bara National administration and the school's parents. The computer science teachers explained how the administration, especially the Bara National chief executive office (CEO) who they called "Sir," would audit their curriculum to check that it was sufficiently rigorous. Additionally, they explained that "Sir" expected the curriculum to be covered in an academic year so that the students could seamlessly matriculate through the curriculum. Hence, the Bara National administration, especially "Sir," represented another accessory social group who had a high level of influence but a low level of integration in the daily uses of the technology.

Technological Frame

I conclude this case study of Bara National with a discussion of the school's technological frame. The technological frame is the cohesive narrative or the "big picture" of the technology's social construction at Bara National. I start, though, with an examination of technological frame in relationship to the Bangalore Challenge. Earlier in the chapter, I asserted that Bara National, out of all the dissertation's schools, most closely captures the perception of the Bangalore Challenge. I recount why. The school's academics are rigorous. The instruction is fast-paced and didactic. The class sizes are large and, at the secondary level, the students will be competing against each other for honor and distinction. Mathematics, science, and English account for the large majority of the weekly schedule. Knowledge in these subjects is memorized and continually assessed through tests and exams. Finally, the school building itself looks like an unembellished office complex that is the academic workplace for students. The

school's slogans and posters remind students that there is no progress without struggle and that hard work is the way to get noticed. Taken together, the characteristics of Bara National are a striking and, perhaps, imposing picture of the Bangalore Challenge; a picture that does indeed capture the hard work of Bangalore's students. And, yet, this is not the only picture of the Bangalore Challenge, nor is Bara National the only school that represents the contours of this challenge, which I will continue to explore in the next chapter's case study.

Keeping with the picture motif, though, I examine Bara National's technological frame. The technological frame is the sum of the school's social context, interpretations about technology, and stabilization. The technological frame is shared by all of Bara National's social groups and structures their interactions related to the school's computer technology (Bijker, 2010; Prell, 2010). The social context characteristics that I described above are part of that frame. In addition, there are economic characteristics that also shape the frame. For example, the school is located in a middle class neighborhood situated in urban Bangalore. Most of the fifth grade students who attend Bara National are also middle SES in India. They speak English fluently. They can afford polish for their business shoes. They live in homes or large flats with at least six rooms. These dwellings have indoor plumbing so that the students just turn a handle to get water rather than pumping water at a well. All their families own a car and 98% of the families own a home computer. The computer science teachers also are a part of India's middle class. They also speak English fluently and own a home computer. They are teaching specialists who all have a degree in computer science. They have job security and have taught at the school for at least six years.

What SCOT argues is that the students and teachers interactions within this shared social context are part of the school's technological frame; and, in turn, frame gives sense to the fixed

meaning the social groups assigns to its computer technology. One way to examine this technological frame is through the construct of SES, where the technological frame structures the computer lab as a place where knowledge is reproduced for middle class kinds of jobs. And the Bara National students, as middle class representatives, are being prepared with the computer programming knowledge and skills to solidify their future role in the middle class.

Examining the technological frame from the perspective of SES, the computer science curriculum carries on India's middle SES. The computer science preparation secures the Indian middle class through computer programming skills. The logic for the Bara National for such a technological frame is founded on this corollary: (1) Bara National fifth grade students, who are middle class, use the computer lab to practice computer application commands and to learn to think logically; (2) The keyboard command skills and logic are necessary components of learning computer programming; (3) Learning computer programming insures the continuation of the middle SES among the Bara National since a computer programmer is a solid middle class job in India (Nilekani, 2009; Tharoor, 2007); so (4) Therefore, the Bara National computer lab is a place of preparation in computer programming so that the Bara National students can reproduce their position in the Indian middle SES. While this makes for a compelling narrative (and one that is captured in the Bangalore Challenge), is it the only narrative for understanding Bara National? I will take up that question in Chapter 8.

CHAPTER 5

FINDINGS: JINKA PUBLIC SCHOOL

"A ONE LAPTOP SCHOOL"

This chapter reports on findings from a rural elementary school on the outskirts of Bangalore. The school, called Jinka Public, is situated in the center of Jinka village. While only 20 or so kilometers from Bangalore's city center, Jinka Public is remote. The school's red dirt courtyard doubles as grazing area for cows and has just enough room for the occasional car that navigates its way to the school. Where Bara National, the case study from the Chapter 4, might come closest to capturing the Bangalore Challenge; Jinka Public is a school on opposite end of the spectrum. Indeed, Jinka Public is furthest from any notions that education policymakers would have of the measuring stick for educational success in the twenty- first century.

Jinka Public represents a different kind of challenge among Bangalore's elementary schools. It is the challenge of access and preparation. Jinka Public captures the dual challenges of providing access to computer technology and preparing teachers and students to continue to use the technology after its introduction to a school. This chapter's narrative explains how Jinka Public is an example of the budding and dynamic relationship among India's government run public schools and private organizations. Through an investigation of each relevant social group's uses and purposes for computer technology, I also give an account of a larger story within India about the persuasive coupling of technology and English language learning.

Social Context and Relevant Social Groups

Jinka Public School is a government run elementary school in rural Bangalore. As representative of India's innumerable public elementary schools, Jinka Public is an example of a "typical" elementary school in rural India. However, as the chapter's title states, Jinka Public is

also a “one laptop school,” meaning that it has one laptop for the whole elementary school to use. From a cursory reading of the phrase, “one laptop school,” it might be tempting to conclude that Jinka Public is just another story of the barriers to computer technology that exist in India’s rural schools. As I explained in the dissertation’s literature review, resource scarcity is the chief barrier to the integration of computer technology in India’s elementary schools (Azim Premji Foundation, 2008; Banerjee et al., 2007; Iyer & Baru, 2008; Pal, 2009).

While there is much more to the Jinka Public story than just barriers, scarcity is certainly a theme. Not only is there scarcity of computer equipment, which actually is intentional, there is also a lack of consistent electrical power. Blackouts and brownouts occur at a daily rate. The school is situated in a village where most the travel is non-motorized. Walking, usually without shoes, is the main form of transportation. A bicycle is considered a luxury. Most villagers work in the surrounding ragi and millet fields; laboring, often with only simple tool blades, by the bending the back and breaking already calloused hands. Wood fires are the main source of fuel for cooking. Save for the fact that most of Jinka’s villagers carry cell phones; the village has an almost archaic quality of life. A quality that is defined by grit and a reliance on low tech tools like the rope that tethers a cow to a fence.

Although it is within reach of one of Bangalore’s main roads, Jinka Public is quite removed from Bangalore’s high-rises and technology centers. Those who toil in the fields that surround the village are known as the *krishikaru* or field workers. The krishikaru, who are mostly women, use hand-sickles to chop the ragi grain ears from the plant’s stalk. The grain is pressed into bundles. The younger women, some who have infants tied to their hips, balance the bundles on their heads and transport the bundle to the threshing area. Older women working in the fields are burdened with large sheaves of dried ragi stalks. In contrast with the din of

Bangalore's busy traffic, the area around the Jinka village is void of any kind of machinery. The work here is done by hand.

While India is known for its immense cities like Mumbai and New Delhi, the rural, village life still shapes and defines India. More than 70% of Indian geography is rural (ASER, 2011). Deb (2011) contrasts India's urban and rural life. He explains that the world magnifies India's outsourcing industry and computer technology industry as representative of Indian life. Yet, India is still centered in villages and shaped by an agrarian lifestyle. Close to 400 million Indians are employed in farming (Deb, 2011). The agrarian portrait of India captures the life in the Jinka village. About three hundred people call the village, "home." Yet, home is a loosely understood word, because many of the villagers are migrant laborers who have to travel from field to field to help with planting and harvesting. Other villagers are day laborers who go to Bangalore to work on construction projects. The children of the krishikaru and the day laborers make up the population of Jinka Public.

School and classroom description. Jinka Public is the centerpiece of the Jinka village. The school day is six hours long, starting at 10am and ending at 4pm. The school serves 63 students across first grade to seventh grade. Jinka Public is comprised of three main buildings: the primary school (for first grade to fourth grade), the upper primary school (for fifth grade to seventh grade), and the small lunch hut where elderly village women prepare the "mid-day" meal for the children.

The primary school building is a concrete pagoda like building with Spanish tiles on the roof. Four pillars support the building's front balcony. These four pillars are decorated with India's tri-colors (green, white, and saffron). The upper primary school building is a barracks style structure that is also supported by tri-colored pillars. A red dirt courtyard separates the

buildings. A flagpole, also painted with tri-colors, stands in the courtyard's center. The Jinka Public students start the school day around the flag pole. The morning routine includes raising the Indian flag, singing songs, chanting a prayer, and doing some yoga style stretches. Adjacent to the flagpole stands the village's water well. Throughout the day, the Jinka villagers go to the well to collect water for cooking. Additionally, women gather at the well to clean stainless steel plates and wash clothes. The well also serves as the watering hole for the village livestock. It is common to see calves tied up next the well. The villagers and the Jinka Public School students routinely bless and feed the calves scraps of food.

I spent most of my time in the upper primary building. The building is partitioned into two rooms: (1) the science and social studies room; and (2) the language and literacy room. The science and social studies room is also the homeroom for the fifth grade students. There is only one desk in this classroom and it is reserved for the teacher. The desk sits at the front of the classroom next to the chalkboards. Students sit on the concrete floor and use their book bags as makeshift desks. The book bag becomes a place to prop up a book for reading and a surface to rest an elbow when writing.

The language and literacy room is divided into two sections. There is the classroom section where the students sit on the charcoal-colored, concrete floor in rows of three behind long wooden lectern style desks that stand just a half a meter high. The other section contains a large staff room table. The teachers use this table as a central place to grade papers, eat lunch, talk with the village elders, and meet with visitors. Almost every wall in the upper primary building is decorated with posters and murals. The posters are translated in English and in Kannada, the state language of Karnataka. Most murals, though, include just the Kannada script.

The variety of murals provides an interesting visual text. For example, the murals on the wall by the chalkboard show the colors of the rainbow, the moon's phases, and colored diagrams of a solar and lunar eclipse. The two side walls are painted with multiplication tables, math symbols, the Earth's lines of latitude and longitude, the solar system, and the human digestive system. The back wall is dedicated to India's history and geography. A political map of India is painted in one corner and a district map of the State of Karnataka is painted in the other corner.

The language and literacy room is packed with posters. Agricultural posters prevail. For example, two posters next to the chalkboard showcase illustrations of tropical fruits and vegetables. Both posters are brightly inscribed (and a tad self-aggrandizing) with titles that state: The Latest Literacy Wall Chart Poster for Children. The English name for each fruit and vegetable is at the top of each picture while the Kannada script is situated at the bottom. Affixed above the posters of fruits and vegetables is a homemade poster, called "Uses of Domestic Animals." This poster shows pictures of animals like cows, goats, sheep, and dogs. A sentence about each animal is written in English and Kannada script. For example, the poster's first animal is a cow and next to the picture it reads (in English), "This is a cow, it gives us milk." I counted over 100 posters and murals on the walls of Jinka's upper primary building.

The teacher's staff room has a wide collection of materials along its perimeter walls. The area is decorated with Indian flags, Indian maps, and a wide collection of posters and framed pictures celebrating Hinduism and India's famous men. A black slate chalkboard hangs on the wall opposite the table. Above the chalkboard are framed portraits of Hindu deities, Gandhi, Nehru, Ambedkar, and Swami Vivekananda, who the Jinka teachers' explained "was the guru who brought Hinduism to the United States." Green, gold, and red tinsel garlands adorn the frames. The focal point is the middle frame, which was about twice the width as the other

pictures. Dressed in speckles of cardinal and gold, the frame showcases a trio of Hindu gods. From left to right, the threesome included: Saraswati, goddess of education and knowledge; Lakshmi, goddess of wealth; and Ganesha, god of success and happiness.

The curriculum and the laptop. Jinka's curriculum is based on the Karnataka State Syllabus (SSBC). Jinka is a "Kannada medium" school that follows India's National Curriculum Framework. Regular school attendance and dropping-out of school are challenges in India's rural schools. Jinka Public is not immune to these challenges. To boost attendance and lower the drop-out rates, the Indian Government and state governments instituted a variety of "schemes" and programs. Providing a mid-day meal (i.e., lunch) is an example of a scheme to ensure that children stay in school throughout the day.

Another example is a program called *Nali-Kali,* which means joyful learning. Nali-Kali is a kinesthetic type of learning strategy that Karnataka's government-run public school teachers use to motivate their lower elementary students to stay active. The strategy involves singing, dancing, and lots of movement. The Jinka Public lower elementary teacher demonstrated a Nali-Kali based math lesson on factors that included a grouping game where students run to form group sizes based on a number the teacher calls out. The State of Karnataka introduced Nali-Kali as a program to make school more appealing to younger elementary children.

The Jinka Public laptop program is a scheme to keep upper elementary students motivated to attend school. The laptop was provided through a Public-Private Partnership (PPP) program with a Bangalore based non-governmental organization (NGO), which I will call the SSA Foundation. Being that Dell Computers is one of the SSA Foundation's donors, the Jinka Public laptop is a Dell with a 15 inch screen. The laptop operates on a free and open source (FOSS) system called Ubuntu.

Jinka Public's "one laptop school" program starts at the fifth grade. The school's fifth grade students share the laptop during their English language class period. Additionally, all of Jinka Public's upper elementary students are allowed to "sign out and take home" the school's laptop. The fifth graders, many of whom have older siblings, explained that the laptop is at the place they live about once a week. In sixth grade, the SSA Foundation distributes the students a USB two gigabyte (2 GB) thumb drives to store projects and documents. The USB thumb drive is the property of the student and becomes another source of motivation to raise school attendance. Students use their USB drive to save Writer (a FOSS word processor) documents and pictures they create using Etoys or Tux Paint. They also save their report card on the USB drive and short progress reports (written in English) that they take home and explain to their parents. The seventh graders are responsible for monitoring the laptop's battery and re-charging the battery as needed. Additionally, Jinka Public teachers assign one seventh grade student as the laptop leader or as they would say, in Kannada, the "laptop *magu*," which means the laptop kid or child. The laptop magu is usually a boy who the teachers identify as responsible, confident with the computer, and has an aptitude for speaking in English. This boy brings the laptop around the village to whoever checked it out. The laptop magu mentors the fifth grade students in using the laptop and provides basic technical support.

The teachers. Of Jinka Public's staff of four teachers, there are three male teachers and one female teacher. The three male teachers dress in long slacks, open dress shirts, and sandals. The female teacher dresses in a traditional Indian sari. Two male teachers are responsible for the instruction of the school's fifth graders. Mr. Kathir is responsible for teaching science, social studies (or what the Jinka teachers refer to as "social"), and math for Jinka Public's upper elementary students. Mr. Pahal is in charge of teaching the three-language formula required in

Karnataka's government-run public schools: Kannada, Hindi, and English. Both teachers are in their late 30's and have been teaching at Jinka Public for over 10 years. Both learned to use a computer on their own. Neither teacher owns a home computer and reported that they use the school's laptop about three times a week for updating students' grades and records.

The students. Eleven students are in the fifth grade class. Of these eleven, there are six girls and five boys. Jinka Public was the only school in this study where the children did not wear school uniforms. The boys dress in long slacks and polo-style, collared shirts. The boys often roll up their slacks at the pant leg and wear belts that almost wrap twice around their waist. Girls wear long dresses or a traditional salwar kameez. Most the girls arrive at school with a *bindi*, or red dot, on their forehead. The girls and boys walk to school barefoot.

The majority of students live in small, brick and mud dwellings called *kutchas*. These hut-like dwellings have either a thatched roof or a roof fashioned from pieces of metal. The kutchas have one or two rooms and are void of plumbing and running water. Food is cooked on a wood fire. While the students live in small kutchas, it is interesting to note that 72% of the Jinka Public fifth grade students indicated that their families owned a television. All the Jinka Public students indicated that their families owned a cell phone.

Interpretative Flexibility

Interpretative flexibility means how a relevant social group's interprets the reasons for why they are using a certain technology. Like I did in the Bara School chapter, I begin this section by offering two snapshots of the ways that the fifth grade students used the school's laptop. The snapshots provide examples of the "curriculum in use" or how teachers and students designed learning experiences around the laptop. Earlier I introduced the laptop magu, a seventh grade boy who takes care of the laptop. During the school day the laptop magu supports students

in their operation of the FOSS programs installed on the laptop. In the first snapshot, the laptop magu is guiding a fifth grade student in a language related activity.

Typing English antonyms. A boy and a girl sit barefoot on a dusty concrete floor of an empty school classroom. The boy is a seventh grader and is known as the laptop magu. The girl is in fifth grade and is still learning how to use the computer. Both children sit with their legs crossed and with their book bags directly in front of them. A black, Dell laptop computer rests on the boy's book bag. Next to the boy is a piece of paper that has English words printed on it. The boy explains that "sir" (i.e., Mr. Pahal, the language teacher) gave him the paper to show the girl how to type into the laptop. Using the laptop's touchpad, the boy shows the girl how to click on the OpenOffice Writer program icon.

Writer is a FOSS word processing program that is similar to Microsoft Word. The boy opens Writer and creates a table with two columns. Using the laptop's touchpad, the boy changes the font size to 18 point and clicks on the italics button. He presses the Caps Lock key before he instructs the girl with one simple Kannada word "*nodi,"* which means watch or look. The girl draws in closer. The boy begins typing the words from the paper onto the screen. In the left side column the boy types "day," he mumbles the word as he taps the keyboard. The girl also echoes the word, "day." The boy hits the tab button. Then he brings his index finger to the laptop's touchpad and navigates to Writer's toolbar. He re-clicks the font button and changes the size to 18. He also clicks the italics button.

In the right side column, the boy types "night." Again, he whispers the word as he types. The girl repeats and says, "night." By the time the boy finishes, he has typed in the left column: day, young, far, short, laugh. On the document's right side column he has typed: night, old, near, tall, cry. The boy highlights the left side words in red and the right side words in green. He

takes out a USB thumb drive, inserts it in the computer, saves his document and opens up a new file. The boy turns to the girl and says in Kannada, "*neevu trimaadi*," which means now you try. This is the girl's clue that it is her turn to type. The boy hands the girl the laptop and she proceeds to set up the document the same way and types the same English antonyms listed on the sheet of paper their teacher gave them. When she finishes typing, the girl's document looks almost exactly like the boy's except she highlights all of her words in orange. The boy shows her how to highlight the left side words in orange and the right side words in blue. She repeats the words one more time and they save her document to the laptop magu's USB thumb drive.

Analysis of typing English antonyms. This snapshot captures a common way that the Jinka Public fifth graders use the school's laptop. So what does the snapshot tell? First, snapshot shows an interpretation, among the Jinka Public teachers and students, that the laptop should be used for English vocabulary practice. This use is not only evident from the typing and organizing of English antonyms, but it also captured in the language the Jinka Public teacher used to write out the list of antonyms. Second, in this snapshot, the fifth grade student is copying a text. Copying is a use and a meaning. The fifth grade students use the laptop primarily to copy English words. This type of copying reflects the teachers' pedagogical practice and belief that copying is a way to build word recognition and develop vocabulary.

While copying was the common way the fifth grade students used the computer, the snapshot also shows some opportunity for creative expression. For example, in the first snapshot the students highlight the text they have created in different colors. Finally, the snapshot shows how the laptop magu, rather the one of the teachers, guides the fifth grade student in her use of the laptop. The Jinka Public laptop belongs to the students. Student responsibility of the laptop is one of the SSA Foundation's conditions when donating a laptop to a rural school.

Copying a solar eclipse with Etoys. Another time I observed the laptop magu showing a fifth grade boy how to create a drawing with the Etoys program. Etoys is a FOSS created for kids to create sketches, drawings, and diagrams. The students use Etoys primarily for sketching and drawing diagrams. Here is an example of how. Two boys huddle together around the Jinka Public laptop. The laptop rests on the older boy's book bag. The laptop magu, who is the older boy, shows the younger boy, who is a fifth grader, how to create a picture using Etoys. The laptop magu points at the screen and instructs the younger boy to click on Etoys. The younger boy obeys; he opens a new project and clicks on a paintbrush icon. A small white screen appears along with a toolbar with features and colors on it. The laptop magu points to a mural of a solar eclipse. The laptop magu tells the boy to sketch that diagram with Etoys. The boy uses the Etoys toolbar to draw the solar eclipse in black and white. Although the classroom mural was written in Kannada script, the laptop magu helps the younger boy label his sketch in English. When the younger boy finished filling in his drawing with color, the laptop magu saved the drawing on a USB thumb drive.

Analysis of copying a solar eclipse with Etoys. The second snapshot also shows an example of copying. Yet, in this example the copying includes a translation of the solar eclipse mural into English. Like the first snapshot, this second snapshot shows the prominence given to the English language when using the laptop. Figure 2 shows a screenshot image of the younger boy's sketch before he colored it in with the aid of the Etoys toolbar. Except for the English and some broken lines, the younger boy's drawing was similar to the classroom mural.

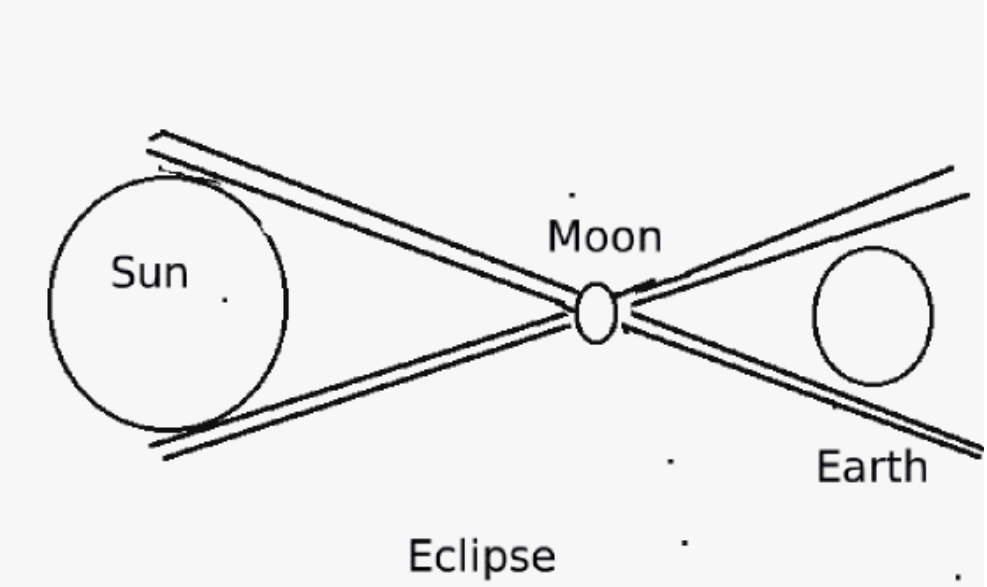

Figure 2. Screenshot of Jinka Public fifth grader's solar eclipse sketch using Etoys.

The snapshot also shows the students' versatility in using different types of FOSS software, like Etoys, to create artifacts on the laptop. From time to time, I refer back to these two snapshots to highlight and probe ways that meanings for the laptop manifest through uses.

Teachers' interpretations. From their interviews and questionnaire responses, Jinka Public's two fifth grade teachers shared about the school's laptop and swiftly converged on a central interpretation. Indeed, both teachers explained that the main purpose for the Jinka Public laptop was for the students to learn English. The first interview question I asked was, "What two words or phrases do you think of when you hear the word computer?" The Jinka Public teachers' responses included, "enjoyment," "motivation," "a help to learn about places," and "a help to learn fast between kids." As I continued to ask questions, English language learning was most important among the Jinka Public teachers' interpretations. For example, when I asked, "What do you understand as the purpose of using the laptop in school?" Mr. Kathir, the science and social teacher, replied, "We live in a competitive world, where you have to know the computer. Our kids become competitive when they know English and science. The laptop helps

them learn English." Mr. Kathir's interpretation echoes the Indian sentiment about English as the language of global dexterity and opportunity (Advani, 2009). Mr. Pahal, the language and literacy teacher, explained how the "laptop helps the kids to learn English fast." I followed-up on his response by asking, "How so? How do you think the laptop helps the kids to learn English?" Mr. Pahal replied by explaining, "The computer [he points to the laptop's screen] is in English. The keyboard is in English. So the kids learn English to make the computer and keyboard work." Mr. Pahal's emphasized the importance of understanding English as the foundation for operating the laptop or "making the keyboard work."

Mr. Kathir discussed making the keyboard work through the skill of typing in English. He explained it this way, "Typing is for learning English. If a child types in "planet" and gets an error then the program marks it as an error. When he goes to correct the error, he then learns the way to spell the English word." Like the first snapshot illustrated, typing English words into a Writer, the FOSS word processer, was a common laptop activity for the fifth grade students. Both teachers brought up the importance of the students learning to type. Learning to type, though, meant something quite different from what some might think of as correct finger placement on the keyboard. Typing tutorial software was neither installed on the laptop nor was it discussed by either teacher. However, when the teachers discussed typing it was in the context of English vocabulary building. Mr. Pahal, for example, discussed the concept of "fluency" in reference to learning to type. Mr. Pahal explained, "The kids should know how to type. The kids will get fluency in English while they learn to type on the laptop. And from the typing their fluency in English will improve."

Even though the interviews were translated from Kannada into English, I followed what both teachers said because of how often they repeated certain English words. Typing was one of

those words and fluency was another. When I heard Mr. Pahal say fluency, though, I was a bit surprised and asked, "How do the students build English fluency on the laptop? What do you want them to do to build this fluency?" Mr. Pahal shared a couple examples, "I give words to look up in the dictionary and to type into a Writer document. They also type singular and plural English words and opposite words." Mr. Pahal's idea of fluency had more to do with typing, copying, and producing English words on the laptop, rather than smooth verbal communication. Additionally, typing was associated with copying English words. Similar to what the fifth grade girl was doing in first snapshot, typing was the pathway to English vocabulary and to spelling.

English language learning was the teachers' main interpretation for student laptop use. Within that interpretation they shared three important outcomes that English language learning via the laptop offered their fifth grade students. These outcomes provide a deeper layer of understanding regarding the prominence the Jinka Public teachers put on English language learning. Motivation, confidence, and collaboration were all outcomes (or outgrowths) of the main interpretation of English.

The Jinka Public teachers discussed motivation in by using phrases like "a way to learn" and "makes the life better." Additionally, in their questionnaire responses, the teachers strongly agreed with the statement that the use of the computer motivates students. Both teachers mentioned how they noticed students' attendance improved once the laptop was introduced to the school. Yet, throughout the interviews, both teachers discussed motivation in the context of learning English. For example, I asked, "Why are your students motivated to use the laptop?" Mr. Kathir explained that the students were motivated since they "see the computer as a way to learn English and they want to learn English because it will make their life better." Mr. Pahal

also added, “They see that English will help them the most in life. So they spend a lot of time learning to type in English and become familiar with the English keyboard.”

Developing confidence was another repeated outcome for the laptop’s purpose for learning English. I asked a question about whether or not the students’ use of the laptop was helping to prepare the students for the future. Both teachers affirmatively stated that they believed the laptop was helping their students for the future. I followed up by asking, “How so?” Mr. Pahal explained that the laptop will help the students when they go to secondary school. He believed that they would have more confidence in their English language and in operating a computer because of Jinka Public’s laptop program. Mr. Kathir shared that use of the laptop, “Makes life easier for these kids. They will continue to use the laptop to learn English. The laptop helps them to grow in confidence in their English.” The teachers’ interpretation was that students gain confidence from learning English with the laptop.

Collaboration was a third outcome of learning English with the laptop. For example, the teachers both strongly agreed with the questionnaire statement that asked about whether the use of the laptop increased students’ interaction and collaboration. The teachers also emphasized how the students support one another in their use of the laptop. According to the teachers collaboration had other benefits. For example, collaboration helped to increase sharing and reduce the amount of arguments. Since there is only one laptop, sharing is a norm that helps to support the laptop’s maintenance. Put more simply, the teachers perceived that student-led collaboration as a key part of the limited conflicts over Jinka Public’s single laptop.

Students’ interpretations. In the student focus group interview and questionnaire, the students shared similar interpretations about the school’s laptop. I conducted my interview with all 11 fifth graders. My first interview question was the same as the teachers’ interview, “What

words or phrases do you think of when you hear the word computer?" The students responded, mixing English with Kannada, by sharing the following associations, "typing [repeated three times]," "English [repeated twice]," "games," "typing my name," "typing my parents' names," "Etoys," "ball game," "Writer program." The students mentioned the words "typing" and "English" the most.

As a follow-up to the first question, I asked the students about the language they use to type into the laptop. The students responded in unison, "English, sir." I continued to inquire about the students' perceptions of the relationship between English and typing. I asked, "Do you think that typing on the laptop helps you to learn English?" Again, students echoed, "Yes, sir." I replied, "How so? How do you think that typing on the laptop helps you learn English?" A fifth grade boy student started in, "Everything we type on the laptop is in English, so when we use the laptop we learn English." Another boy student added, "The laptop's keyboard is in English that helps us learn English." Much like the Jinka Public teachers, the Jinka Public students also identified typing on the laptop as the way to learn English. Also, students' interpretation of typing was more akin to data entry or tapping English words on the keyboard rather than a finger placement system.

The students' questionnaire responses align with their teachers' interpretations of English and the laptop. All the Jinka Public students either agreed or strongly agreed with the statement: I do better in reading, social, and second language (English) when using the computer. Students also agreed or strongly agreed that they enjoyed using the laptop. The students also shared their teachers' belief that increased motivation was an outcome of using the laptop. On the questionnaire survey, the Jinka Public students all agreed or strongly agreed with the statement: I am motivated to learn in school when I use a computer. In the focus group interview I asked,

"Do you believe that that knowing how to use the laptop will help you in the future? If so, how so? If not, why not?" Once the translation was finished, the students started in with almost in one accord by exclaiming, in English, "Yes, sir." Then the students began quickly chattering in Kannada to explain why they believed that way. The translator asked them to speak one at a time. The first student to speak up said this in Kannada, "*Laptop neevu nam deshage haege bandira, haage naavu nim daeshage barthare*." Translated into English this means "the laptop is how you [they were speaking to me] were able to come to our country, so in the same way, we learn the laptop to be able to go to your country [the United States]." In this example, the students were motivated to use the laptop because of a future opportunity it could afford them. Motivation was also encapsulated by a place, like the United States of America, that represented, in the students' perception, success and a good life.

Collaboration was another outcome of the Jinka Public single laptop program. On the questionnaire students reported that they agreed or strongly agreed with the statement: I work better with other classmates when using a computer. Student collaboration is a key way that Jinka Public's students learn how to use the laptop. The second snapshot depicted a fifth grade student creating a solar eclipse diagram with Etoys. It is an example of how Jinka Public's fifth grade students characterized collaboration common to Jinka Public school. Collaboration involves working with an older student. Students discussed how much they relied on the laptop magu and other seventh grade students to mentor their uses of the laptop's software. Students also explained that if they encounter problems with the laptop they talk to the laptop magu and students who are older. The students did not identify the Jinka Public teachers as people they would go to when they encountered a problem with the laptop.

Finally, while the students agreed that the laptop helped them to learn English, they all disagreed with the statement regarding whether they learn more from the computer or from a textbook. This was in contrast to their teachers' responses to the same question item on their questionnaire. On the teacher questionnaire, Mr. Kathir and Mr. Pahal both agreed with the statement: Students learn more from the computer than from a textbook. As a follow-up to the students' responses, I asked the students about why they disagreed with the statement by inquiring, "So why do you think you learn more from a textbook?" One student offered this explanation, "The laptop is for typing, but the book tells what is important." Another student stated, "I learn more from the book because I use the book more than the laptop." These responses suggest an important distinction in the students' interpretation of the laptop. The laptop is a tool for the imitation rather than for erudition.

At Jinka Public, the students use the laptop as a tool for copying English vocabulary. In a different time, a slate and piece of chalk or a notepad and pencil would have been equivalent technological examples of the laptop's primary purpose. While the students interpreted the laptop as a fine tool for word processing and duplicating diagrams, the laptop was not perceived as a tool for searching and finding information. Of course, with no Internet connectivity, Jinka Public's students do not have access to the World Wide Web so that limits how they can use the laptop as a tool to search and gather for information. However, there are FOSS software titles, including encyclopedias and English language tutorials that use a communicative approach for language learning that can be downloaded. But such software was not downloaded to Jinka Public's laptop.

Summary. Both the students and teachers at Jinka Public shared the same primary interpretation about the school's laptop: it is for typing in English. While both relevant social

groups believed that the laptop was useful for learning English, the approach to learning English was based on vocabulary building through copying words. Thus, the laptop was seeped in pedagogy of replicating written English words and duplicating classroom murals.

Both of Jinka Public's relevant social groups perceived that the use of the laptop garnered many positive outcomes. One outcome was that the laptop was a tool for practicing and developing confidence with English language vocabulary. Another outcome was that the laptop's use also increased motivation to learn English. The teachers explicitly voiced this interpretation through explanations like "the kids want to learn English to make their life better" and "they see that English will help them the most, so they spend a lot of time learning to type in English." Echoing the teachers' sentiments were notions that students were motivated to use the laptop to learn English because doing so meant a better life, a better future, and, perhaps, even a chance to go to the United States of America. One student explained it this way, "If I use the laptop then I can use faster. Then if I learn English from using the laptop, I can come to your country to spend time there."

Stabilization

In the previous section I explained that English language learning was the shared interpretation, among the students and teachers, for the purpose of the Jinka Public laptop. Yet, how did such a shared interpretation emerge? As a review, stabilization is the process by which an interpretation, albeit unitary, is agreed upon by relevant social groups and becomes a fixed meaning. Jinka Public reflects two types or categories of stabilization: consensus and domination. There is a consensus among the students and teachers about the English language learning purpose, but there is also domination by the SSA Foundation, the accessory social group that provided the laptop. SCOT asserts that for technology's meaning to become stabilized there

has to be a match between what the relevant social groups describe as a technology's purpose and how they use the technology. For example, in the case of Jinka Public, both relevant social groups described the laptop as a way to learn the English language and their use for the laptop was consistent with such a description. Like the snapshots depicted, students used the laptop for English vocabulary building.

Consensus happens when both relevant social in groups move toward a shared meaning in their rhetoric and their rhetoric converges on a singular definition of the technological artifact. Furthermore, consensus occurs when both relevant social groups have a shared role in the technology's uses. The Jinka Public students had "ownership" for the laptop. Ownership, here, does not mean that the students purchased the laptop; rather I use the word ownership to mean the responsibility the Jinka Public students had for the care and upkeep of the laptop. The teachers agreed to share and, even, to give the students ownership of the laptop to complete English language and vocabulary building exercises.

The degree of laptop ownership that the Jinka Public students had was somewhat surprising given the fact that in elementary schooling, especially Indian elementary schools, domination of the teachers over the students is more typical. Indeed, it also evident in the literature that the Jinka Public's level of consensus is uncommon in Indian elementary schools, especially in government-run public schools, where students are told what to do and do it without question (Kumar, 2004; Sarangapani, 2003). At Jinka Public, the laptop was reserved for the students. Both teachers, Mr. Kathir and Mr. Pahal, acknowledged this fact in their explanation of how the laptop is student maintained and supported by the laptop magu. The students concurred, in both word and deed, with their teachers' sentiments and would go to the laptop magu, rather than to the teachers, if they had any problem with the laptop. In the context of the Indian

schooling system that has a strong tradition of teacher authority as well as a hierarchical structure, how did such consensus happen at Jinka Public School? To understand the consensus at Jinka Public, I turn to examining the domination of the SSA Foundation as accessory social group.

The SSA foundation's vision and laptop program. The stabilization at Jinka Public School would not be possible without the SSA Foundation. Why? The school would not even have its one laptop without this Bangalore based NGO, whose mission is to improve and nurture India's government run public schools through a decentralized model based on developing basic skills. The SSA Foundation influences, and stabilizes, the meaning making at Jinka Public School in two ways. First, the SSA Foundation transmits the vision for how students should use the Jinka Public laptop. Second, the SSA Foundation provides the laptop and incentives.

The SSA Foundation's mission and vision focuses primarily on improving India's rural public schools by partnering with state governments across India to decentralize the government's role in operating the school. It seems ironic that the SSA Foundation gets involved with state governments so that the governments will become less involved, bureaucratically, with their schools. The SSA Foundation's relationship with state governments is an example of the rise in popularity of India's PPPs to support: teacher development, English language learning among rural elementary students, and technology integration. The SSA Foundation represents the private side of the PPP through their involvement as a NGO with the Indian government. Among a number of schemes the SSA Foundation implements, the "one laptop per school" program has specific goals and objectives towards the enhanced delivery of elementary education in its schools.

To examine the SSA Foundation's vision for how Jinka Public should use the laptop, I visited and interviewed the SSA Foundation's chief executive officer (CEO), Mr. Amit. I started

by asking Mr. Amit questions related to why the SSA Foundation decided to support government run public schools? He explained that over 80% of India's elementary schools are government run. Yet, government run public school resources and infrastructure are deplorable. Teacher absences, student drop-outs, lack of electricity, few functioning toilets as well as the lack of separate toilets for genders, and a lack of teaching materials are issues that are common to government run public schools in rural areas.

According to Mr. Amit, supporting government run public schools was a "no-brainer" because these schools serve the largest amount of students. Mr. Amit stated it like this, "Government run public schools represent the scale of India's problems and the scale of possibility—we desire to have a sizable impact throughout India's education system so the best place to begin is with government run public schools." After discussing with Mr. Amit the larger mission of the SSA Foundation, I inquired, "What words or phrases do you think of when you hear the word computer?" Mr. Amit answered, "I think of the computer as a valuable resource for learning. Also, the computer is a valuable tool that children should use for building basic skills in English." Throughout the interview, Mr. Amit referenced Dr. Sugata Mitra's (2001) work with the "Hole in the Wall" project. The SSA Foundation's vision for it laptop program in schools was based on Mitra's work in that the laptop should be a tool to spark the child's natural curiosity. Additionally, the laptop should allow the child to meet the goals that he or she is interested in attaining. Mr. Amit stated that the best way for teachers to guide their students' curiosity is to allow the children to plan out their own programs for using the laptop.

Without specifically mentioning John Dewey, Mr. Amit echoed Deweyian sentiments about the relationship of the child to learning experiences. For example, when Mr. Amit explained that students should be able craft their own plans for using the computer, it reminded

me of what Dewey (1902) emphasized about letting the "child's nature fulfilling its own destiny" (p. 31). Also, Mr. Amit's insistence that the child's use of a laptop stimulates further learning resonates with Dewey's explanation of the relationship between stimuli and experience so that children begin to assert themselves in their learning. The child taking ownership and the lead for the school's laptop is the bedrock of the SSA Foundation's vision. It is a vision influenced by Mitra's work and congruent with the philosophy of John Dewey.

But why only one laptop per school? Throughout the rest of this section, I address that question. While the SSA Foundation is involved in teacher trainings and other school development programs (e.g., providing library books and materials like paper and pencils), their main donor organizations are most enthusiastic about supporting technology based programs. Donors are apt to invest in something tangible. Mr. Amit explained that the donors want to know that their money is going for something that can help students today and in the future. Thus, a laptop seems like a sound investment because it has the potential to be used right away and also to prepare a child for the future.

Mr. Amit explained that top donor organizations, like Dell Computers, would prefer to donate more laptops so that more children have access. Yet, the SSA Foundation prefers a one laptop per school program rather than a larger donation of computers. Mr. Amit explained that the SSA Foundation starts by asking donors the following question, "How many laptops does a rural school need?" Mr. Amit answered by explaining, "One, a school should start with one laptop. To start, a school only needs a single laptop." Mr. Amit starts the SSA Foundation's donor presentations this way to guard against unrealistic expectations from donor organizations. Technological deterministic language (i.e., technology governs human actions rather than human beings giving purpose to technology) creeps into the purposes and potential of donor investments

in technology. For example, according to Mr. Amit, donors and Indian government officials often invest or support investments in technology with the belief that learning outcomes will increase by just having laptops in schools. Mr. Amit explained how donors and government officials view laptops as an "automatic deliverable" that donors believe should produce. This kind of view leads to a rush to provide as many laptops as there are students so that there will be more automatic results and success stories. Yet, Mr. Amit cautioned that such a view is naïve to the realities of schooling in rural India, where resources are scarce and electrical power is unreliable.

For example, Mr. Amit explained that India's rural schools have a tight budget for electricity; often, the school principal is given a certain amount of rupees per month to run the electricity and when those rupees run out so does the electricity. Mr. Amit stated that for a rural school, like Jinka Public School, to run a ten monitor computer lab they could go through their monthly electricity budget in five days. Mr. Amit concluded, "So, opportunity cost is an issue related to computers in rural areas. Schools often have to choose either to operate the computers for a couple of days or to run lights and ceiling fans for most of the month." I followed up with Mr. Amit by asking, "If electricity was not an issue or you were able to identify donors who would cover the cost of electricity would you still be favor of a one laptop per school program?" Mr. Amit quickly replied with, "Yes, absolutely."

Mr. Amit went on to explain how all his years in software development (he worked for Dell Computers in Texas for many years before moving back to Bangalore) helped shaped his view of computers. In Mr. Amit's understanding a laptop is a "computing resource." He explained that a laptop is a great tool for computing, composing, and even creating. Yet, in order to maximize the benefits of a laptop, a person needs to plan out how it is that she or he will use

the computer. Mr. Amit's philosophy about the importance of planning was a key element to SSA Foundation's belief regarding how students should use their school's one laptop. The SSA Foundation's approach is to teach students to plan out the work they intend to do on the laptop. .

Mr. Amit made a distinction between the laptop as a learning resource (i.e., a person can use the Internet to learn more about a topic of interest) and a laptop as a material resource (i.e., it is manufactured and requires a care and upkeep in order to function properly). Mr. Amit stated that donors and state governments often forget about the laptop being a material resource. Scarcity has an unintended outcome that people typically are better stewards of resources that are scarce. Thus, the provision of only one laptop at Jinka Public is another way to develop the school community's perception of the high value in the laptop's material resource.

The SSA foundation as an accessory social group. Since the SSA Foundation provides the vision for how Jinka Public's teachers and students should use the laptop, they stabilize the purpose for the laptop at the point of entry. The SSA Foundation is an example of an accessory social group as they have a high degree of influence in the meanings for the laptop, but are not involved into the day to day uses of the laptop. The SSA Foundation's organizational vision for their one laptop per school program dominates the process of stabilization at Jinka Public School. The outcome of domination is a material donation, the laptop. The laptop serves as a reminder of the organization vision for how the teachers and students should use the donation.

This is what is happening at Jinka Public School; the SSA Foundation, as an accessory social group, provides the laptop on the condition that the laptop is reserved primarily for student use. Likewise, the SSA Foundation installs the FOSS software, like EToys and OpenOffice, which the Jinka Public students can access and explore. It is important to note that all the FOSS software is in English. So even though Mr. Amit did not discuss at length about English

language learning as part of the SSA Foundation vision, the Jinka Public students identified that they needed to know some English to access the laptop. By using the laptop's software the Jinka Public students have opportunity to practice and build their English vocabulary. Finally, the SSA Foundation trains the teachers in regards to how they can guide their students in using the laptop, but with the expectation that the students will be the ones in charge of the laptop. In these ways the foundation dominated the meaning making of the Jinka Public laptop once the laptop entered the school.

The process of stabilization at Jinka Public School provides an interesting case study of the social construction of technology. Accessory social groups, like the SSA Foundation, can play the role as the arbitrator of power. Bijker (1995) employs Anthony Giddens scholarship on power in his analysis of how stabilization is laden with power dynamics. According to Giddens (1979), power is "the transformative capacity to harness the agency of others to comply with one's ends" (p. 93). Applying this definition to the case of Jinka Public, the SSA Foundation wields power through their vision for the "one laptop program." The vision includes a transformative capacity.

The SSA Foundation uses the laptop as a tool (and incentive) for transforming the teacher-student power relationship. Rather than domination of the teachers' meaning for the laptop there is more of a consensus about the meaning; and, certainly, a consensus about the use. Indeed, the Jinka Public students are empowered to use the laptop and, if they have a problem, to go to the laptop magu for help. Thus, the SSA Foundation's vision for the laptop also influences the consensus among the Jinka Public relevant social groups related to how the students maintain the laptop. There is something curious about the stabilization at Jinka Public—students actually have more ownership (and to some degree, power) regarding the laptop's use. Students refer to

the laptop as “our laptop,” as if there was a collective ownership. This reflects the SSA Foundation’s notion (and domination) that the technology is best served in the hands of the students. While the Jinka Public teachers still give students assignments (like the typing out antonyms described in the first snapshot) to complete on the laptop, the laptop is understood as a tool that is primarily for the students. Throughout this dissertation, I have touched on the highly structured, hierarchical relationship between Indian students and teachers. Kumar (1991) characterizes the relationship as adding to “the legitimacy of teacher dominance – a supremacy that has been sung about in India since yore” (p. 89). However, when it comes to the school’s laptop, this supremacy is being put to the test at Jinka Public School as the teachers and students have a consensus about the laptop.

Technological Frame

Jinka Public offers another narrative, and technological frame, in understanding the Bangalore Challenge. While this narrative does not make for sound bites in speeches, it does represent the challenges of elementary schooling in India’s rural areas. The Jinka Public narrative includes a PPP that seeks to equip students with the opportunity that a laptop symbolizes. Such an opportunity includes the chance to develop technological awareness while practicing English vocabulary. This opportunity, though, is framed by the scarcity of the technological resource. Jinka Public has only one laptop for all the students to share. Even though the SSA Foundation has intentionally designed their program with scarcity in mind, the one laptop per school program is a reminder of the persistence of scarcity. Many of the Jinka Public fifth grade students would be identified by the Indian Government as Scheduled Caste (SC) or Dalits, which means that the students belong to a class that is underprivileged and historically disadvantaged within India. The students walk to school barefoot. Most students

live in one or two room kutchas where there is no indoor plumbing and food is cooked over firewood. A bicycle, if a student's family is lucky to own one, is the main source of wheeled transportation. In sum, the Jinka Public's technological frame is defined by the lower class in India's rural areas.

Examining the Jinka Public narrative and technological frame from the perspective of SES, the laptop program becomes a tool for the opportunity to learn English. Indeed, both the teachers and students interpreted the laptop as a tool for learning the English language. This interpretation is echoed in a Jinka Public fifth grader's response to a question about the laptop's importance, "Everything we type on the laptop is in English, so when we use the laptop we learn English." By learning English via the laptop, the Jinka Public students believed that there would be greater opportunities towards the promise, of what their teachers called, "a better life." A better life meant a life that was not confined to manual labor or working in the fields like their parents; it meant a life that was different from a lower SES. Simply put, a better life meant the opportunity to gain possible entry into India's middle class.

The SSA Foundation's vision for their laptop program frames the relevant social groups' perception that the laptop could lead to a better life. The foundation's organizational vision goes beyond just providing laptops, the foundation advocates for the village children. The laptop program is the foundation's way of equipping the Jinka Public students not only with technology skills, but also with confidence, responsibility, and the power of ownership. Thus, the Jinka Public technological frame is informed by the perception that the uses for the laptop can equip students to break free of their lower SES. How? The students use the laptop to increase their English vocabulary and to practice operating a computer while, at the same time, gain experience being the laptop's owners and stewards. The skills, speaking in English and operating a laptop,

are necessary for entry into India's middle class (Advani, 2009; Guha, 2008). The Jinka Public teachers shared this sentiment as they explained how their students recognized that English and computer technology will "help them out the most" in their lives. Thus, examining technological frames from the SES construct, the logic, at Jinka Public, goes like this: (1) The Jinka Public fifth grade students, who are a part of a lower SES, operate the school's laptop to practice typing English vocabulary words; (2) Typing in English helps the students learn the English language; (3) In India, speaking the English language, along with operating a computer, are the keys to social mobility (i.e., a better life); and (4) Therefore, the Jinka Public students use and perceive the laptop as a tool for the opportunity to learn English. While this makes for an interesting narrative about the school's technological frame is it the only narrative for understanding Jinka Public?

CHAPTER 6

FINDINGS: AADU INTERNATIONAL SCHOOL

"WHERE CREATIVITY AND CURIOSITY ARE COUSINS"

This chapter reports on findings from Aadu International School, an exclusive private school located just outside of Bangalore's urban sprawl. "Creativity and curiosity are cousins" reads the purple and white sign hanging on the walls of the Aadu International School's fifth grade classrooms. Like the "QUALITY work" poster at Bara National School, the "creativity and curiosity" sign is more than just an alliterative slogan. The sign is an interpretation for the purposes of being apart of Aadu International School. As I observed from my field research at Aadu International, creativity and curiosity informed the ways the fifth graders used the school's computer technology. This school's case study puts a new spin on the Bangalore Challenge. While the academics are rigorous at Aadu International, the school values an inquiry based learning approach over a rote memorization approach and unit projects rather than unit exams. Indeed, the Aadu International story illustrates a different response to the Bangalore Challenge as the school ventures out in developing its students' entrepreneurial and leadership skills by fostering their creativity and curiosity.

Aadu International is where Bangalore's wealthy and globalized send their children to school. About 40% of the students are internationals and expatriates. The students are the sons and daughters of diplomats, entrepreneurs, and executives from many of Bangalore's large technology companies like Infosys and Wipro. The school is situated in the space just before where "rural" Bangalore begins and "suburban" Bangalore ends. Coconut and palm trees bound much of the surrounding environs. It is an area of Bangalore where a person can see water buffalo trudging through rice fields that butt up against the walls of gated communities that

guard large homes with two car garages. It is the encroachment of affluence on the idyllic; an area where modern India meets ancient India. Such areas are becoming more and more common as Bangalore increases in population and prestige.

Social Context and Relevant Social Groups

Aadu International School is situated about two kilometers from a major roadway that is the home address for a number of Bangalore's elite private schools. Grain fields and a lush forest of tropical trees surround three sides of the school's perimeter. On the fourth side, a gated community of new homes, advertised as being "a slice of Bangalore's luxury lifestyle," completes the perimeter. Across the road from the gated community is an immense brick making factory and kiln. While the Aadu International students arrive on campus in luxury buses or in their parent's Scorpio SUVs, groups of day laborers walk barefoot along the same road, preparing for a day of stacking and loading bricks onto lorry trucks. The laborers live in kutchas (clay constructed dwellings) that are located in the forest in front of the school campus. This is life in India, where the poorest often live just across the road from the wealthiest.

The rustic setting changes once the Aadu International security guards push open the stately, wrought iron entry gates. Immediately, the setting turns palatial. Jasmine bushes frame the school's limestone walkways and fill the entire campus with a fragrant smell. Magnolia trees, with their cream colored flowers, dot the landscape. Crescent shaped flower beds, in a colorful array of marigolds, border the entry way to each of the campus's four main buildings. Each building's architecture resembles an elegant mixing of the Monticello with the Taj Mahal and is dressed in white marble with towering Corinthian columns. Playgrounds, athletic fields, tennis and basketball courts, and an open-air amphitheater with enough seating for 800 people are all contained within the 40 acre campus.

Unlike many of Bangalore's elementary school campuses that just have dirt patches where students play, Aadu International School has spacious lawns of green *doorva* grass. The lawns are well-manicured and quite inviting. During my field visits to Aadu International, I observed students lounging, reading books, strolling together, and playing games of soccer and cricket on the school's lawns. The campus is unique and unlike any school campus that I have ever visited. It seems befitting of royalty.

The elementary school and schedule description. The fifth grade classrooms are located in the elementary school building. An impressive marble staircase, with 32 steps, ascends up to the middle floor entry doors of this three floored building. The Aadu International spacious cafeteria, called the "canteen," takes up the entire ground floor. The second and third floors contain classrooms for the third grade, fourth grade, and fifth grade students. Additionally, there are separate classrooms for art, drama, Hindi, music, and a special education resource room. The elementary school building's hallways are spacious with high ceilings. Students' art work and inspirational posters hang on the walls of these hallways. For example, one poster shows a picture of Leonardo da Vinci with the following quote, "Knowing is not enough, we must apply. Be willing is not enough, we must do."

Like the rest of Aadu International, the elementary school day begins at 9:15am and finishes at 3:45pm. In between those times, the students receive a 15 minute morning break and a 55 minute lunch and recess break. Class periods are 55 minutes long, with a total of six class periods per day. On Mondays, the fifth graders start their first period morning class in their homeroom section. During this first period class, called Unit of Inquiry, the teachers lead a discussion on whatever integrated unit topic the students are currently exploring. The Unit of Inquiry typically integrates science and social studies related themes. Throughout the week, the

fifth grade students have daily periods of English, math, and Unit of Inquiry. Additionally, their last period class (i.e., sixth period) is known as Class Teacher's Time, which the teacher gets to choose what the students will do. More often than not, the Class Teacher's Time is a continuation of the Unit of Inquiry. The fifth grade students use the time to work on unit projects that showcase their learning throughout the unit. Altogether, the Unit of Inquiry class period comprises about 40% of the fifth grade weekly schedule.

Additionally, the fifth graders have two periods of a second language throughout the week. For the second language class, the students can elect to take French, Hindi, or Spanish. The remainder of the weekly schedule includes special periods like: art, assembly, dance, information and communication technology (ICT), library, physical education, and sport hour. While the fifth grade students have a special ICT class period, the ICT teachers, along with the other specials' teachers, integrate their content and instruction with the students' Unit of Inquiry.

Classrooms. At Aadu International School, I spent my field time observing in the school's three fifth grade classrooms. Additionally, I observed the fifth graders ICT classroom sessions in the school's computer lab. The computer lab is a terrace style room with four raised platforms where desks are grouped side by side. The lab has an assortment of 28 older model Compaq and Samsung desktop computers. The computers are arranged in paired learning stations. Each learning station comes equipped with a 15 inch monitor, keyboard, headphones, a computer mouse, and the computer's central processing unit (CPU). Two of the desktops computers seemed to be in disrepair and did not turn on. The lab is roomy and has four large widows. An air conditioning unit, which the ICT teachers turn on during afternoon class sessions, is situated in the back corner of the lab. A digital LCD projector hangs from the ceiling and projects on to the classroom's main wall. All the paired desks face this main wall, as the

wall is the focal point of the computer lab. The computer lab is efficiently organized in this spacious but rather plain looking room.

The fifth grade classrooms are spacious but certainly not plain. Rather, the stately classrooms showcase the students' work and inquiries. From almost the floor to the ceiling, the classroom is decorated with student artifacts, project posters, newspaper clippings of current events, as well as signs that explain the school's philosophy and mission. Many posters are created by students and include a multimedia mix of computer images and handwriting. Near the entry door, a sign announces the school's vision statement, "To create leaders of tomorrow through whole-education and life-long learning." Below the vision statement is the school's Latin motto, *In Omnia Paratus*, which means 'prepared for all challenges.' Beside the posters, the front wall of each classroom is equipped with a Smartboard, which the teachers and students operate using desktop computer station. The students sit in comfortable chairs behind wood and steel desks. Each individual desk has a flip-top space where the students store notebooks, textbooks, and school supplies like crayons and pencils. The desks are arranged in small groups of three or four. Students collaborate in these small groups, but also can move their chairs to easily form new groups.

The curriculum and technology. Aadu International is an English medium school that is affiliated with the International Baccalaureate (IB) program. Headquartered in Geneva, Switzerland, IB is an international educational foundation that promotes an inquiry-based curriculum. Among educators and policymakers, IB affiliation carries prestige and cultural capital related to citizenship preparation in a global society. Schools that are affiliated with the IB curriculum are required to post in their classrooms IB related materials like: (a) the IB Learner Profile and (b) the IB Research Cycle. The IB Learner Profile is a list of educational

qualities and characteristics, based on the mission of IB, of being an IB student. The characteristics include being: communicators, balanced thinkers, risk-takers, inquirers, knowledgeable, caring, reflective, and principled. The profile, according to IB, is also meant to be a source of motivation to the students and they begin to recognize that the profile stands for a person worth becoming.

The IB Research Cycle is designed as a flow chart that is organized around a circle of words: question, sort, plan, gather, synthesize, and evaluate. It is common to hear the Aadu International teachers ask their students about where they are in the research cycle. Students will reply with: "Sir, I am a still gathering my resources" or "Ma'am, I am synthesizing my research right now and putting it in my own words." The IB Research Cycle is not just informational text to adorn classroom walls; it is text that is integrated into the daily classroom discussions.

The three fifth grade classrooms share a set of six laptops. Generally, each fifth grade classroom has access to the laptops at least once a day. Since they are sharing the laptops with multiple people, students bring their own USB thumb drives to save their documents. The six laptops are Acer brands with 14 inch monitors. The students share a laptop in small groups; with three to four students using a single laptop. In my student focus group interview, I asked the students about sharing the laptop and they all said they did not like it. They explained that sharing a laptop with four people works okay when they were all researching the same topic, but was difficult when everyone is trying to research separate unit projects. The students manage this difficulty by taking turns on the laptop. Sometimes the fifth grade teachers will borrow a laptop set from the fourth grade teachers. Yet, even with six extra laptops, it still means that most of the fifth grade students have to double up on a laptop.

The Aadu International teachers recognized advantages and disadvantages to the laptop scarcity. Learning to cooperate was a perceived advantage as the students had to negotiate and collaborate while using a single laptop. The teachers noticed how this helped students to compromise and share ideas more readily in their research. The disadvantage was the inefficient use of time when students had to do their own research. Starting in sixth grade, Aadu International has a "one laptop per child program" where all the students get their own laptop. The teachers explained that sometime in the next couple of years the school administration was hoping to purchase laptops for the fifth graders as well.

The teachers. There are three homeroom teachers in the fifth grade. The teachers are well supported. For example, each homeroom teacher has a teaching assistant. The assistant's role is to support the homeroom teacher, escort the fifth grade students to their specials and to lunch, and occasionally teach a class period of English or mathematics. The school also employs several specialists. At the elementary school level the specialists include: an art teacher, a French teacher, a Hindi teacher, an ICT teacher, two librarians, a music teacher, a physical education teacher, two Spanish teachers, a Special Education teacher, and several instructors for sporting activities like equestrian. Throughout the week, the fifth graders interact with a dozen teachers and specialists besides their homeroom teacher.

Of the homeroom teachers, one is male, Mr. Bibin, and two are female, Ms. Darsha and Ms. Gopa. The ICT teacher, Ms. Lalan, is also a female teacher. Aadu International was the only school in this study where the female teachers dressed in a style different than the traditional sari or a salwar kameez. Instead, the female teachers frequently wore Indian styled *kurtas* with slacks or dark jeans. The male teacher wore a tie, short sleeve shirts, and dressy pants. The teachers are in their thirties and all have been teaching at Aadu International School

for over five years. The three fifth grade teachers, Ms. Darsha, Ms. Gopa, and Mr. Bibin, had a bachelor's degree in education; whereas, the Ms. Lalan, the ICT teacher, had a master's degree in computer science. On the teacher questionnaire survey, all the teachers indicated they own a home computer and that they use a computer on a daily basis. Ms. Lalan indicated that it was at the university where she learned how "to use computer technology in teaching." Conversely, the three fifth grade teachers indicated they learned to teach with computer technology on their own.

The students. The fifth graders are divided into three sections, each of which has 21 – 23 students. Altogether there are 66 students in fifth grade. Of the 66 students, 65 students completed the student questionnaire for a 98% response rate. The student who did not complete the survey was absent the day I distributed the questionnaire. Almost 40% of the fifth graders were born in a country other than India. The gender breakdown of the fifth grade class, as a whole, is 56% boys and 44% girls, which is skewed a little higher for boys compared with the school's overall gender distribution of 53% boys and 47% girls. Such a percentage, though, is consistent with literature in India that shows a higher percentage of boys are enrolled in private schools as compared with girls. The higher percentage is related to a choice many Indian families make in sending their sons to private school rather than sending their daughters (Advani, 2009; Ramachandran & Sharma, 2009)

Three days a week, the students wear green and gold track suits with an athletic shirt emblazoned with the school's crest. On Tuesdays and Thursdays, the students dress in their formal uniform. The boys' formal uniform includes a green, gold, and red striped tie with a white, short sleeve dress shirt and khaki pants. The girls' formal uniform is the same except khaki skirts replace the khaki pants. Regardless of what day it is most the students wear brand-name athletic shoes like Adidas, Nikes, and Skechers.

On the student questionnaires, 100% of Aadu International fifth graders who completed the questionnaire indicated that their family owned a cell phone, computer, radio, and television. Likewise all the fifth graders indicated that their families cook meals using a stove top oven that is connected to a cooking gas cylinder. Almost 70% of the students indicated that they live in homes or apartments with eight or more rooms, including the kitchen and bathrooms. More than 80% of the students have 200 books in the place they live. For transportation, all the students indicated that their family owns a car and about two-thirds of the students also indicated that their family owns a motorcycle or scooter. Almost 91% of the students indicated that they own a personal bicycle. A majority of the fifth graders (63 %) also own an iPod and personal cell phone. The Aadu International students' demographics represent India's upper class.

Interpretative Flexibility

The teachers and students shared a unitary interpretation for the school's computer technology that was centered around the IB's curricular emphases on research and inquiry. I start this section on interpretations for the school's computer technology by offering two snapshots. In the first snapshot, I share a Unit of Inquiry class session in Mr. Bibin's class. The students are discussing their research projects and, as a class, decide to use a mind mapping Internet based program, called Bubbl.us, to sort and synthesize their ideas for their upcoming unit projects. In the second snapshot, I illustrate an example of fifth grade student using a classroom laptop to research and create a PowerPoint presentation.

Inquiry through mind mapping. The fifth graders at Aadu International School start their morning by discussing their current unit projects. Mr. Bibin, their teacher, tells them to update the other students in their "desk group" about the status of their project idea. After ten minutes or so, Mr. Bibin asks the groups to wrap up their discussions and face the Smartboard.

Mr. Bibin then says, “Now I would like to hear what you have discussed and find out about you unit project ideas. First, let’s review the topic for this current unit, what is our inquiry?”

Students raise hands and others begin to call out answers. Mr. Bibin calls on a girl student. The girl says, “Sir, our inquiry is about how the world works. We are learning about the world’s different ecosystems.” Mr. Bibin smiles and replies, “Yes, that is right. Now in your groups you discussed topics related to this inquiry. How many of you have a topic idea for your unit project?” Ten hands shoot into the air. Mr. Bibin continues, “Okay, so how many of you are still deciding on your topic idea?” A couple of students blurt out, “me,” while a dozen hands go in the air. Mr. Bibin explains they will discuss their unit project ideas and that he would like to use the Smartboard for this activity. Mr. Bibin asks the students about their suggestions in regards to a computer program they could use to help organize and keep track of the discussion. One student suggests typing the ideas in a Microsoft Word document and then another student says that they should create a mind map with bubbl.us. Bubbl.us is a free, Internet based mind mapping program. The mind map idea is the most popular and quickly agreed upon.

Mr. Bibin types in “bubbl.us” in the Internet address bar and signs in to his class account. Mr. Bibin asks if any students would like to be in charge of creating the mind map. Two girls volunteer. Mr. Bibin directs them to sit by the desktop computer connected to the Smartboard, listen closely, and map out the discussion. Mr. Bibin then asks the class, “Okay, what should be our central idea for the center bubble?” Students call out different suggestions like, “human choices,” “ecosystems,” and “the environment.” Mr. Bibin replies, “Are there any other ideas you have for the central bubble?” A boy student calls out, “Sir, how about ‘threats to our ecosystems’?” A girl student raises her hand and responds to the boy, “But not everything that humans do is a threat to the ecosystems.” Mr. Bibin then asked the girl student, “Well what do

you suggest?" The same girl continued, "Sir, I think we should have two bubbles in the middle with a line connecting the two. One bubble can be called 'human advancements' and the other bubble should be 'ecosystems.' Then we can look at how the human advancements affect ecosystems." This suggestion sounded like a good idea to the rest of the class. The girls operating the desktop computer created two central bubbles with an arrow connecting the "human advancements" bubble to the "ecosystems" bubble.

Mr. Bibin then asks the students to call out the ecosystems that they have been researching as part of their small groups. Students exclaim, "deserts," "choral reefs," "forests," "mangrove swamps," "savanna," and "tundra." All these examples are added to the mind map as smaller bubbles around the "ecosystems" bubble. Mr. Bibin asks, "Okay, now what are examples of human advancements. Let's name some and the students creating our mind map will try to type in as many as they hear." One by one students share advancements like: "entertainment," "clothes," "instruments," "shoes and boots," "food," "diesel and petrol," "furniture," "buildings," "jewelry," "stationery," and "medicine."

Mr. Bibin praises the students for their responses. Mr. Bibin asks, "Of all the advancements on our mind map, what is one that you use at school on a daily basis?" A boy student replies, "Sir, we use a lot of stationery." Mr. Bibin nodded his head and stated, "Yes, good." Mr. Bibin asks the class, "What materials make up the stationery we use?" The students call out: "paper," "erasers," "pencils," and "markers." These responses are added to the "stationery" bubble. Mr. Bibin picks the paper example. He asks the class to think about how paper is made and the ecosystems that paper production affects. Without prompting, the students in charge of the mind map create a line from the "paper" bubble to the "forests" bubble on the ecosystem side. The class discusses how paper production affects the forests. Mr. Bibin

concludes the discussion by pointing to the mind map and explaining that the students should create their own mind map, either in their notebooks or on a classroom laptop, to synthesize the information for their unit projects.

Analysis of inquiry through mind mapping. This snapshot captures a common use for Aadu International's computer technology. Mr. Bibin integrates the use of the Smartboard into a class discussion about the fifth graders' unit projects. Furthermore, the class uses the mind mapping tool (i.e., bubbl.us) as a way to organize and record the flow of the classroom discussion. The mind map connects to the inquiry driven discussion. Thus, the purpose for the using the technology matches the pedagogical purposes of the discussion. The computer technology helps to facilitate the discussion, but the classroom discussion is most important. The snapshot also captures the role of inquiry at Aadu International. The commitment to inquiry is reflected in the way Mr. Bibin phrases his questions and develops a line of questioning. The questions help guide the students in a synthesis of the Unit of Inquiry themes and ideas; while the mind map helps all the students to stay connected in a visual way to the discussion.

Creating a unit project presentation. As part of their Unit of Inquiry, the fifth graders complete a unit project. There are several unit projects options for the students to choose from, including: conducting interviews, creating a PowerPoint presentation, creating an informational poster, and writing essays. More the 50% of the fifth graders choose to create a PowerPoint presentation for their project. This snapshot illustrates an example of how one student created a PowerPoint for her unit project.

It is the last period of the day, called Classroom Teacher's Time, and the fifth graders get the whole 55 minute period to work on their unit projects. The classroom is abuzz with noise and activity as students discuss their projects with one another, take inventory of their resources,

and rummage through their desks for books and computer printouts that will aid in their research. A couple students immediately start working on one of the six classroom laptops. I watch as one fifth grade girl arranges her desk with a laptop on the left hand side of the desk and a notebook on the right. The girl opens up two programs on the laptop. One program is Google, which the girl uses as her primary search engine for her research. The second program is Microsoft PowerPoint. She opens a new PowerPoint document and on the title slide she types, "Human Advancements in the Tundra." On this same slide, she also types her name. Then she clicks on the Google window and begins searching for images of tundra. She finds an image of polar bears walking through a landscape of ice, snow, and short grasslands. The girl copies the image and pastes it to her title page.

The girl pauses to look into her notebook. She then creates six more slides on her PowerPoint. On each new slide, she types in titles, one title per slide: (1) Tundra Description, (2) Tundra Ecosystem, (3) Human Advancements, (4) Human Threats, (5) Question - Drilling Oil, and (6) Sources. The girl clicks on the tundra description slide and begins typing in a bullet point description of the tundra. She copies most of the description from notes that she had earlier recorded in her notebook. The girl continues this same process for adding content to slides. On the Human Advancements slide, for example, she types in bullet pointed phrases like "dog sleds," "snow machines," and "oil pipelines." She also includes "oil pipelines" with the bullet points on the Human Threats slide. Once the girl clicks on the Question - Drilling Oil slide, though, she goes back to Google and begins to search using this exact phrase: oil drilling in the tundra. She begins clicking on some of the suggested page links, but soon goes back to the Google main page. She tries her search query again, but this time she includes quotation marks; her search looks like this: "oil drilling in the tundra."

After narrowing her search this way, the girl begins navigating the suggested page links. She stops on a page that discusses the "pros and cons" of drilling for oil in Alaska National Wildlife Refuge. She begins to take notes in her notebook. For about three minutes, she continues to read the web page and take notes. She also clicks on the website address, copies it, and then pastes the website address on her PowerPoint slide entitled Sources. The girl then goes back to the slide called Question – Drilling Oil. For this slide, she selects the two textbox option. In left side textbox, she types, "For." On the right side textbox, she types, "Against." She lists some bullet point arguments for each side. Later, the girl told me that during her presentation she was going to have her classmates debate this question about "drilling oil in the tundra." Before the girl gives the laptop to another student to use, she types in two more web addresses that she previously wrote in her notebook. She also saves her PowerPoint project to her USB thumb drive.

Analysis of creating a unit project presentation. The second snapshot illustrates the research and design process that a fifth grader employs to create a PowerPoint. The PowerPoint is the convergence of the girl's creativity and curiosity. The student is constructing her unit project with Google and PowerPoint, which are two computer applications that she, like other Aadu International students, finds useful. Google extends her inquiry and allows her to search for the information regarding whatever unit questions she is exploring. PowerPoint gives her a tool for presenting that inquiry; a tool to craft and communicate the inquiry. Like most Aadu International students, she keeps applications open on the laptop and she is deft at clicking back and forth on the applications as she synthesizes her research.

Yet, while these software programs aid her in the research, they are secondary to the main point of her activity: research synthesis. The snapshot captures the school's emphasis on

synthesizing information. Like the first snapshot, this second snapshot shows the integration of the IB curriculum model with the uses for the school's computer technology. From time to time, I refer back to these two snapshots to further illustrate the interpretations and uses for computer technology among the Aadu International social groups.

Teachers' interpretations. According to the Aadu International teachers, their fifth graders primary purpose for using the school's computer technology should be for research and inquiry. The centrality of this purpose was made clear with each interview that I conducted. To organize this section on teacher interpretations, I first report what the three fifth grade teachers shared and then I report on what Ms. Lalan, the fifth grade ICT teacher, stated in the interviews. I found that Ms. Lalan's responses throughout the interview process were more focused on ICT and the school's computer technology. By parsing out Ms. Lalan's response, I aim to show some of the nuance at Aadu International in terms of teachers' interpretations.

I started each teacher interview with the question, "What two words or phrases do you think of when you hear the word computer?" In response to the first question, the fifth grade teachers replied with the phrases like, "A device to help and assist me," "a tool for communication," "an underutilized teacher tool," "displaying audio-visuals," "a tool for creativity," "a device for endless opportunities and for searching endless information." Ms. Lalan, the ICT teacher, answered the same question by explaining, "I have more than two phrases. I think of the computer as a tool for learning. The computer helps with three types of learning: project-based learning, game-based learning, and collaborative learning."

The fifth grade teachers responses reflect their interpretation that the computer is a tool that people use for creativity, communication, research, and for multimedia display. The teachers also identified that the computer was a tool with endless possibilities, yet something that

was underutilized by teachers. The ICT teacher, Ms. Lalan, identified the multiple ways that a computer could be a "tool for learning." She included projects, collaboration, and games as the ways a person learns with the computer. Taken together, the teachers (including Ms. Lalan) responses reveal a nuanced interpretation of the computer as a tool that has several applications including: research, inquiry, creativity, and collaboration.

However, as I continued on with the interview questions, each teacher began to narrow in on a unitary purpose for the school's technology: research and presentation of inquiry. For example, my next interview question was, "What do you understand as the purpose of using the laptops and computer technology in this school?" In their responses, the teachers, including Ms. Lalan, focused on research. The lead fifth grade teacher, Ms. Darsha, explained that, "What we want to get them to do is to think with the computer. So we give them research to conduct on their own. The computer is a device for the children's own learning and thinking." In his interview, Mr. Bibin concurred with Ms. Darsha's sentiments and explained, "The primary purpose for the laptop is to learn how to research. Research is the way the children form their own ideas about our Units of Inquiry. Then the children use their research to create their own presentations." The teachers emphasized how research was part of owning ideas (i.e., learning to think on their own). In addressing this question, Ms. Gopa also discussed the importance of research as idea ownership and connected this with the IB Research Cycle, which was posted in each classroom. Here is how Ms. Gopa explained the relationship, "I want the children to understand that they are not just pulling information from Google, which is not okay. They need to organize the information, synthesize it, and evaluate it to show they have processed the information."

In her response to the same question, Ms. Lalan, the ICT teacher, also discussed how students began to process information and, thereby, gain ownership for their ideas via research on the school's computers. Ms. Lalan explained, "Research is the basic skill they learn here, it is the basic purpose. They can find out for themselves about different topics and ideas. Research is the way that life-long learning happens." I followed up with Ms. Lalan, by asking, "How so? How does research encourage life-long learning?" Ms. Lalan continued, "Research is the platform for their studies here at this school. When the students know where to find information, how to find information, and, most importantly, how to process information then the students are prepared to think for a lifetime."

In their responses, the teachers described the outcomes of research in proprietary language; students would know how to process information and own their ideas. During my data analysis, I was surprised by how often the teachers used the word "own" and made references to the students "owning" their ideas (i.e., the synthesis of their research). Indeed, idea ownership or proprietorship was the outcome the teachers stressed throughout their interviews. Additionally, the teachers often expressed that the ownership of information and ideas was developed through presentation. Presentation was a second part of the Aadu International teachers' unitary meaning and purpose for the school's computer technology.

The teachers spoke about presentation in connection with characteristics from the IB Learner Profile and with the synthesis component of the IB Research Cycle. For example, Ms. Gopa identified that presentation was how the students developed as risk-takers and communicators (both qualities of an IB Learner) in their presentations. Here is how Ms. Gopa put it, "The children learn to communicate their ideas and even take risks when they create a PowerPoint and present it." Ms. Darsha shared similar thoughts as she framed the importance of

presentation to the IB Research Cycle, “They love making PowerPoint presentations. The presentation helps them to synthesize their research into main points and ideas. They use the PowerPoint to organize and communicate the synthesis of their inquiry.” The second snapshot captures a strong example of how a student organizes a PowerPoint presentation to communicate her synthesis of inquiry.

Ms. Lalan, the ICT teacher, also identified PowerPoint presentations as important. However, she connected the importance of PowerPoint with the development of specific computer skills rather than practicing the IB Research Cycle. Ms. Lalan explained it like this, “I want them to know how to integrate sound effects, transitions, clip art, and video clip to their PowerPoint presentations. The children should know this to enhance the presentation of their PowerPoint.” Although Ms. Lalan’s interpretation for computer technology related more to the developing specific computer skills, the fifth grade teachers centered their interpretation on the development of idea ownership through research and presentation. The teachers referenced many parts of the IB curriculum model, including the IB Learner Profile and IB Research Cycle, in framing this interpretation. Indeed, the students’ Google based searches was a way the students would begin the research cycle by collection information about the topic. The Aadu International students would continue to use the Internet to synthesize their research and make it their own. Presentation was also a key interpretation among the teachers. Presentation allowed the students to become knowledgeable inquirers of a certain topic and communicate that topic to the whole class. Such practice was helping the students develop the qualities of an IB Learner.

Throughout the interviews, each Aadu International teacher shared concerns they had in regards to the school’s computer technology. One concern was digital citizenship. The teachers wanted to be sure that their students were academically honest. Ms. Darsha used this exact

phrase to explain how the students go about their research, “The first thing we insist on is academic honesty. We insist on citations and not just “copying and pasting” but giving proper credit to your sources. This is also part of their synthesis of research.” Likewise, in her interview, Ms. Gopa reiterated similar sentiments, “I want the students to know how to quote a website and know to properly cite resources. This is the way students learn to sort out their ideas from the ideas of others and give proper credit to websites that influenced their inquiries.”

While academic honesty was an issue the teachers raised, cyber safety was the concern that the fifth grade teachers discussed the most. The three fifth grade teachers indicated that cyber safety was of utmost importance since their students were using the Internet, primarily Google, to research their unit projects. By cyber safety, the teachers meant that students should responsibly navigate the Internet by not looking at inappropriate pictures or websites and immediately closing any pages that made them uncomfortable. While the school had software filters installed on all their computer equipment that would block students from clicking on dangerous websites, the teachers connected cyber safety to the IB Learner Profile of a student being both principled and responsible. In short, the teachers understood cyber safety as part of what it means to develop students who are “the leaders of tomorrow.”

Students’ interpretations. The students confirmed their use of Google on both the student questionnaire and in their interview responses as part of the student focus group. I start with the student questionnaire. First, all the Aadu International students agreed or strongly agreed that they enjoyed using the school’s computer technology. Next, in response to the question about what they believe to be the most important purpose of the computer, almost 75% of the students indicated that “searching for information” was most important. A couple of

students even wrote in Google next to the "search for information" choice. The popularity of Google as a search engine was confirmed in the student focus group.

My first interview question to the student focus group was the same as the teachers' interview, "What two words or phrases do you think of when you hear the word computer?" The students responded with the following words and phrases: "research (repeated seven times)," "presenting (repeated four times)," "PowerPoint," "Google," "Facebook," "Skyping," "communication," "games," "information." Since so many of the students mentioned research, I followed up with a question about why research and the programs they use to research. A student in the focus group explained, "Research is what we do in our units. It is part of the inquiry. I basically use Google to research. I can find whatever I am looking for with Google." Another student added, "Google helps me to find my information faster. It is the best source for up to date information." Other students also shared about Google, explained how they start their research using the Google search engine or go to Google when they needed images for a PowerPoint they were creating.

I also asked the student focus group what the computer helped them to do at school. The students narrowed in on two main themes in relationship to this question. The first theme was exploration. One student explained, "I like it when our teacher give us a website and tell us to explore it. I explore and it helps me think about the questions we are asking in our unit. I like this way of exploring the Internet." Another student shared, "Exploring using Google helps me to think of all the information available to me through the computer." Here the students focused on how Google, as a computer technology, helped them to explore their unit questions. The computer was a tool for exploring and searching these questions in a faster way. In connection to the speed of exploration that computer technology allowed, another student in the focus shared

how, “I use the computer for searching educational websites and finding information. The computer helps me to find my information faster.” One more focus group student quickly concurred and chirped, “To explore and find research, we also put quotations around the search item in Google. This helps us to find exactly what we are looking for. It helps to cut down the amount of time that we spend searching for information.” Like their teachers who emphasized the importance of research, the students identified exploration and searching as a way to find information for their unit projects.

The second theme was presentations. Related to the question of what the computer helped them to do, the student focus group shared how the computer made it possible for them to not only search quickly, but also to find pictures on Google and include the images in the PowerPoint presentations they crafted about their research. A focus group student explained, “The computer helps me to present my research in more exciting ways. Whatever we are learning in class, we can also learn on our computers. Then I can use the computer to present what I have learned.” Another student added, “I like to use the computer for all my research presentations and unit projects. I think the computer helps with the creativity in my presentations, because I want to find pictures on the Internet and include them in my PowerPoint presentation to better explain my research.”

Summary. The students’ interpretations about computer technology were aligned with the teachers’ emphases on research and presentation. Students were largely in agreement about those purposes. The students communicated that agreement in their responses to a question that I asked about what they thought their teachers wanted them to be able to do with computer technology. For example, here is what one student said, “Mr. Bibin wants us to know how to find good information and to be able to be safe on the computer.” Another student added that,

"If you look right now, technology is changing. The teachers know that and want us to be able to know how to use the computer or any kind of technology for ourselves." As a summation response to the question, a student from the focus group shared, "The teachers want us to know that computer technology is important for research and for how we communicate our ideas. With the computer and technology, we now can communicate ideas to the whole world."

In sum, the Aadu International teachers and their students had a similar interpretation for their schools' computer technology. For the teachers, including the ICT teacher, computer technology was most useful for the students' research and presentation of their inquiries. Additionally, research and presentation were part of the inquiry process for how students began to own their ideas.

Stabilization

As discussed earlier, stabilization is the negotiation and interaction process, among social groups, that leads to a meaning agreement about a school's computer technology. When such an agreement happens, SCOT identifies that a technology's meaning becomes obdurate and fixed so that the meaning goes from malleability to obduracy (i.e., becoming hardened). The meaning then gets adopted into the school's rhetoric and "network of practices" (Bijker, 1995, p. 273). So at Aadu International there was a consensus among the relevant social groups (i.e., teachers and students) about the research and presentation purposes for computer technology. The teachers gave students a certain amount of autonomy within the bounds of cyber safety.

Why the emphasis on research, though? While research was part of the IB curriculum's inquiry based approach, there might be additional reasons for Aadu International's emphasis on developing research skills. Peter Morville (2005), author of *Ambient Findability,* argues a connection between power and research. Morville defines research as information findability,

which is the ability to search, find, and process information. According to Morville, a key to power and access in the twenty-first century is having the ability to find information and process (or synthesize) the information.

The purpose for computer technology use at Aadu International seems to echo Morville's notions of information findability. While research and presentation, which is a form of information processing, are embedded into the IB curriculum, there also seems to be this connection to power. The power comes from proprietorship, or the ownership of ideas. Knowledge and idea ownership were echoed throughout the teachers' interviews. The teachers framed this ownership as the way in which students synthesize information. It seems though there is a relationship to maintaining power.

International baccalaureate as an accessory social group. The teachers' commitment to the IB curriculum was influential in regards to this consensus. I argue that the Aadu International teachers referenced the IB Organization as an accessory social group. However, throughout this section and the rest of the paper I refer to the IB Organization as it is represented by the IB curriculum. By IB curriculum, I mean the set of documents that the IB Organization created to guide schools and teachers about the organization's goals and outcomes. Thus, the IB curriculum is an extension of the IB Organization. In keeping with the definition of accessory social group, I define the IB curriculum as an accessory social group example because of the high level of influence in shaping the curriculums but a low level of inclusion into the curriculum's daily uses. To make that argument, I follow Bijker's (1995) method of "follow the actors." As I discussed in the Bara National School chapter, "follow the actors" method involves listening carefully and making note any groups of actors that a relevant social group repeatedly refers to in their interviews or conversations.

The Aadu International teachers not only referenced the importance of the IB curriculum in their interviews, the IB curriculum mission and materials were posted on all four walls of each teacher's classroom. Not only were the IB Learner and IB Research Cycle documents posted, but the IB Mission Statement was also prominently displayed. The IB mission is the following, "Develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect. Our international education programs encourage students across the world to become active, compassionate and lifelong learners" ("Mission and Strategy," 2008). Rather than computer-based skill foci for computer technology, the IB curriculum encouraged the integration of computer technology into the research cycle. The IB curriculum fostered this integration through a focus on developing students into IB learners who were strong communicators, balanced thinkers, and risk takers

Technological Frame

I started this chapter with a discussion of Aadu International's relationship to the dissertation's larger narrative about the Bangalore Challenge. The chapter examined how Aadu International expands the notions of the Bangalore Challenge even further as it delivers a rigorous curriculum that is based on inquiry methods and emphasizes questioning, synthesizing, creating, and presenting. Thus, Aadu International is an elementary school that is quite a departure from the more traditional pedagogical practices of drill and memorization.

Aadu International's technological frame is different from the study's other schools. Most of the Aadu International students are the children of CEOs, entrepreneurs, and expatriates. The Aadu International students wear trendy, Western-style brands of shoes like Nikes and Skechers. Most students live in homes or upscale apartments with more than eight rooms including the kitchen and bathrooms. The school's upper SES influences its technological frame

and the way the students use the school's computer technology. Each fifth grade classroom is equipped with a Smartboard system that the students also use quite frequently. The students use the school's technology for research and enhancing their unit projects. The teachers emphasize that such research promotes ownership of ideas and original thinking. Thus, the computer technology provides a tool research, presentation, and the ownership of ideas in order to spur original thinking.

The technological frame of Aadu International is the shared socio-contextual space and includes SES. In examining Aadu International's technological frame I turn to Anyon's (1981) scholarship on school knowledge and social class. Anyon's study of the construction of knowledge in New Jersey's elementary schools was part of the original inspiration for this current study. Although, the questions and theoretical frame that I used for this dissertation ended up being quite a departure from Anyon's work, there were a couple interesting findings related Aadu International the schools in Anyon's study.

One of those shared findings relates to Aadu International's technological frame being a combination of Anyon's definitions of an "affluent professional school" and "executive elite school." Anyon describes the affluent professional school as representative of the upper middle class (in the context of the United States, though). Creativity and conceptual knowledge was the emphasis of the curriculum in this school. The affluent professional school's focus on creativity echoed Aadu International's emphasis on creativity and curiosity being cousins. Aadu International also shared characteristics of an executive elite school, which is representative of the upper SES (again in the context of the Unites States). The curriculum and pedagogy of an executive elite school is based on original thinking and leadership. This is similar to Aadu International's focus on developing tomorrow's leaders who know how to form their own ideas.

In examining Aadu International's technological frame, I inquire about the relationship between the school's upper SES and the meanings assigned to computer technology. Through the construct of SES, one might posit that the Aadu International students, as upper class representatives, are the future leaders and entrepreneurs in not only India, but around the globe. Hence, their value lies not so much in the computer programming skills, but in their innovative thinking, their proprietary ideas, and their desire to lead. Thus, the school's computer technologies are tools that help to facilitate the development of originality. Aadu International School's inquiry-based curriculum and its focus on integrating computer technology throughout the curriculum further encourage the students in their ownership of their ideas. Using these associations with SES, the logic for the Aadu International computer technology could be based on a corollary written like this corollary: (1) Aadu International fifth grade students, who are upper SES, use the school's computer technology to research and enhance their unit projects that are part of the school's inquiry-based curriculum; (2) Research and unit projects help to develop original thinking as students begin synthesize research into their own ideas; (3) Idea ownership and originality are the hallmarks of being strong leaders of tomorrow that are prepared for all challenges; so (4) Therefore, the Aadu International computer technology promotes leadership development through the ownership of one's ideas and original thinking. Such ownership of ideas also fosters an entrepreneurial spirit. Like I stated in the previous chapters, while viewing the findings this narrative through SES makes for a compelling story, is it the only narrative for understanding Aadu International?

CHAPTER 7

FINDINGS: KOMU COMMUNITY SCHOOL

"AN EQUAL OPPORTUNITY SCHOOL"

At the periphery of the Aadu International campus is a kilometer long gravel road that leads to a separate school campus called Komu Community. At the entrance of this school, there is a white sign similar in size to a parking signpost. The bright red letters on the sign greet each visitor with this statement: "You are now entering an equal opportunity school." In response to the Bangalore Challenge, the sign is both a purpose statement and a political statement. In this chapter, I investigate how Komu Community is an example of a school that confounds the Bangalore Challenge narrative by bridging the local village with global community. Indeed, Komu Community is a school that prepares India's most common elementary aged children—the underprivileged children living in villages—with language and technology skills for a successful future and a deep appreciation of their villages.

As the "daughter school" of Aadu International, Komu Community's *purpose* is to provide a high quality education to local village children. The Komu Community administrators and teachers define this "high quality education" as immersed in an English medium curriculum that prepares students with technology skills. Such an education also delivers a *political* message. Unlike Aadu International, which serves Bangalore's wealthiest families, Komu Community is a school for the poor and impoverished. Komu Community serves the very population living directly outside the Aadu International stately gates. As I discussed earlier in the dissertation, Komu Community originated as the way Aadu International chose to comply with the 25% rule in the Right of Children to Free and Compulsory Education Act (RTE). The 25% rule states that all private schools throughout India have to reserve one-quarter of their

classroom seats for underprivileged children. Alternatively, the private schools can construct a separate school building, called an "Equal Opportunity School," that is specifically for underprivileged students living in the area around the private school. Komu Community is an example of such an Equal Opportunity School. The children who attend Komu Community live in villages that are within a five kilometer radius of the school. To carry out its purpose of providing equal opportunities through a high quality education, the Aadu International trustees adopted a community school model for Komu Community. The community school model, which has become increasingly popular among policymakers in developing countries, is a model of education that seeks to empower local communities (Sujatha, 1999; UNESCO, 2008, 2010). One way that community schools empower the community is through their commitment to teach about local customs. Another way that community schools give power to local communities is by directly employing teachers who are from that community. While Komu Community's two administrators are former teachers of Aadu International School, all the Komu Community teachers live in the same local villages where their students live.

Social Context and Relevant Social Groups

The reflection of the local villages is evident even as one walks down the dusty road that leads to the Komu Community campus. Large murals adorn the five campus buildings; the murals show Hindu gods, people working in fields, and dancing celebrations. Signs explain the meaning of each mural. The signs are written both in the Kannada script, the official state language of the State of Karnataka, and in English. These signs are more for visitors than for the students who attend Komu Community. For the students, the murals communicate symbolic meanings of local customs far beyond what 140 words on a sign could capture. The murals are the tangible examples of Komu Community's commitment to being a community school. While

the school seeks to reflect the cultural context of the surrounding villages and people, Komu Community is also a school committed to preparing its students to live in a globalized world. This is evident from the Komu Community mission statement that is showcased near the entry door of each classroom. The statement reads: "Our mission is to prepare twenty-first century citizens possessing a strong sense of the community with a global perspective." The Komu Community administrators believe this mission is best delivered with a curriculum focused on English proficiency and supported with computer technology.

Komu Community is contained within the expansive Aadu International campus grounds, the school is somewhat separated from Aadu International's marble edifices. The distance and remoteness, though, provides Komu Community with a certain distinction. The school campus is designed to look like a village school, albeit one that is quite upscale. Small fields of ragi, millet, and red sorghum surround three sides of the school campus. Coconut trees tower over the grain fields; these trees form a natural border between the school and the forest where many of the area's small villages are located. Before Komu Community created a policy of busing all their students to the school, many of the school's children would walk to school via the forests and fields. Tardiness, among the students, became an issue because so many children would take their time "to smell each coconut," as one Komu Community administrator put it, as they walked to school. So Komu Community now buses all its students to and from the school campus each day. Besides the school buses, the only other motorized vehicles that traverse gravel road to Komu Community are the administrators' compact cars and the occasional Bajaj scooter.

It is common to see families packed on a scooter or walking along the dusty road. The families' purpose is to apply for the chance to get their children selected to Komu Community. Although Komu Community was still in its inaugural year during the time of this study, the

school quickly gained an excellent reputation among the local villages. The school's student capacity is 300 students from first grade to sixth grade. In its first year, Komu Community had over 1200 applicants for their 300 spots. Everyday I visited Komu Community, there were local villagers lined up by the principal's office door to fill out applications for the next academic year. I noticed the earnestness in the villagers' faces as they hoped to secure a seat at Komu Community for even just one of their children.

While the villagers waited in line, I observed many of them curiously scanning the campus grounds, which most likely seemed a bit peculiar. Indeed, in keeping with the idea of a community school, the Komu Community campus was landscaped and manicured to resemble a village. For example, a large mango tree was planted in the center of campus to provide a shady place for the children to congregate. For the villagers, the mango tree must have looked somewhat familiar because in many Indian villages a large tree, typically a Banyan tree, provides a central gathering spot. Komu Community's mural of the *chital*, or spotted deer, striding through stalks of grain depicted an everyday scene. Similarly, the villagers would have recognized the bust of Ravana, the red-faced demon, perched on an overhang warding off any evil spirits. Yet, there were also parts of the Komu Community campus that would likely seem rather strange to the villagers. Children typing away on laptop computers might have sounded unfamiliar. Another curiosity might have been the school's brick privy building that had a steel roof, a separate bathroom areas for boys and girls, and sit-down flush toilets that were plumbed to a septic system. The school's durable materials unveiled the monetary investment to building a first-class community school campus. Yet, there is some irony in the building materials as just the Komu Community construction materials alone would likely have cost more rupees than many villagers would ever hope to earn over their lifetime.

Besides the five school buildings, the campus also included: (a) two large, canopy-like structures; (b) an open-air amphitheater; (c) a playground; and (d) a pond surrounded by a wire fence. The Komu Community teachers and students use the canopies for many different purposes. For example, the canopies serve as stretching area for the students' morning yoga and as a cafeteria sitting area during their mid-day meal. Large, Spanish-tiled roofs on each canopy provide shade from sun and protection during the monsoon rains. The open-air amphitheater was built on a grass berm. Students sit on this spacious berm for the school assemblies and special performances. A walking path surrounds the perimeter of the pond. However the pond is fenced off to keep out the local cattle and to dissuade the children from playing in the water.

The classroom and schedule description. The fifth graders share the large upper primary classroom building with the sixth grade students. A brick wall separates the building's two classrooms. The building is painted in a garnet color that contrasts nicely with the jade-colored roof. Geometric patterned *rangoli* form a decorative border around the building's two mustard colored classroom doors. The fifth grade classroom is rather spacious. Each wall is decorated with bulletin boards. One bulletin board contains hand-drawn pictures of the brain, spinal cord, and nervous system. Another bulletin board contain proverbs like: (a) "Good work attracts good people" (b) "Silence and smile are two powerful tools" (c) "Talk less and work more" (d) "The student's life is a golden life" (e) "Where there is a will there is a way" (f) "Practice makes man perfect" and (g) "Knowledge is power."

The students' desks, 25 in all, take up the classroom's floor space. The desks are arranged in five small groups, with five desks per group. In one of classroom's front corners, a large metal storage locker contains all classroom laptops. In front of the locker, a small table and metal folding chair provide a makeshift teacher's desk. A keyboard rests on top of the table; the

keyboard is attached to a computer that sits on the floor. The teachers use this computer to operate the classroom's Smartboard. Two small sound speakers are affixed above the Smartboard while a large political map of India hangs next to the Smartboard. An LCD projector, which points to the Smartboard, is bolted to an overhead ceiling beam.

Although there are 25 student desks in the fifth grade classroom, there are actually 50 fifth graders who attend Komu Community. To accommodate all these students, the Komu Community school day is divided into two shifts: the morning shift and the afternoon shift. There are 25 students in each shift. The morning shift starts at 8am and finishes by 11:30am so that these students can eat their mid-day meal, which is provided by the school. The afternoon students arrive in their buses just a little after 12pm to eat their mid-day meal. The afternoon shift starts at 12:30pm and goes until 4pm. Regardless of the shifts, though, the order and sequence of the fifth grade daily schedule stays the same. Each school day, the fifth grade students have 5 class periods that are 40 minutes in length.

English and mathematics are scheduled everyday, and on some days, the students have two class periods of mathematics and English. Each week the fifth graders receive 320 minutes of English language instruction and have 240 minutes of mathematics. English represents 32% of the weekly schedule and mathematics takes up 24% of the weekly schedule. Together, English and mathematics are the subjects that the students spend the majority (56%) of their week learning. Throughout the week, the fifth graders also have four class periods (16%) of science, three periods (12%) of social studies, two periods (8%) of second language (Kannada), and two class periods (8%) of information and communication technology (ICT).

The curriculum and technology. Komu Community teachers are trained in inquiry-based teaching methods by staff members from Aadu International. While much of the Komu

Community teachers' pedagogical practices are informed by International Baccalaureate (IB) teaching strategies, the Komu Community curriculum is affiliated with the Central Board of Secondary Education (CBSE). The CBSE has the highest status of all the Indian based curriculum boards and maintains a rigorous, English-medium curriculum. The Komu Community administrators explained that the CBSE curriculum was, as they put it, "too advanced for our children, many of whom are learning English for the first time." To compensate, Komu Community supplements the CBSE curriculum with material from the Karnataka State Syllabus (SSBC).

Even with the SSBC curriculum, the Komu Community teachers still supplement additional resources to help enhance the curriculum. This is due to the fact that the Karnataka-based SSBC curriculum materials are written in Kannada, but the language of instruction at Komu Community is in English. The teachers rely on the school's technology, mainly the student laptops, to help enrich the SSBC curriculum with English based activities. The fifth grade has 25 laptops, one for each student who attends whether in the morning shift or afternoon shift. The laptops are Jetway Ecomos with a 10 inch screen and are connected to the school's wireless network (Wi-Fi) to allow students to access the Internet.

The teachers. At Komu Community, there is one fifth grade teacher, Ms. Mamita, and two ICT teachers, Ms. Eshani and Mr. Tarun. Both ICT teachers have responsibility for ICT teaching. Ms. Eshani is the lead ICT teacher for the fifth graders while Mr. Tarun provides more technical support. Ms. Mamita, the fifth grade classroom teacher, is responsible for teaching the core fifth grade subject matter, including English, mathematics, science, and social studies. Apart from ICT, the only other subject matter that Ms. Mamita does not teach is second language.

The school's Kannada teacher was the second language instructor for all the grade levels. I did not include this teacher in my study because of the limited time and interaction I had with him.

Both Ms. Mamita and Ms. Eshani dress in traditional Indian salwar kameez that they match with a long shawl called a dupatta. Mr. Tarun dresses in business attire and wears long slacks, collared dress shirts, and black dress shoes. The three teachers are in their early twenties and in their first year of teaching at Komu Community School. All three own laptops, which they use on a daily basis. Ms. Eshani and Mr. Tarun, the two ICT teachers, are both working towards their Bachelor of Computer Science degrees and learned to use computer technology in their teaching from their university programs. Conversely, Ms. Mamita, who is finishing up her Bachelor of Commerce (B.Com) degree, indicated that she learned to use computer technology in her teaching from a professional development course. The teachers indicated that their primary purposes for using the laptop were for e-mail and grading.

The students. In the fifth grade, 25 students attend the morning shift and different group of 25 students attend the afternoon shift. Gender parity is one of the core values at Komu Community and the school is intent on keeping class sizes equal in proportion to gender. Therefore, of the 50 fifth grade students, 25 are girls and 25 are boys. In each shift, the boys and girls are mixed so that there are 12 or 13 of each gender. Of the 50 fifth grade students, all of them completed the student questionnaire for a 100% return rate.

The fifth grade students wear a basic uniform. The uniforms are athletic looking and closely resemble cricket wear (as in the sport of cricket). The uniform includes green and gold track-style pants and a matching athletic looking jersey shirt. The Komu Community crest and school name, written in English and Kannada script, are all embroidered on the shirt. The students are required to wear shoes. Most children wear shoes with holes or shoes that are a

couple sizes too big for them. Hindu religious markings on the forehead, such as bindis, or red dots, are common among both the girls and boys. The children are linguistically diverse as Kannada, Malayalam, Tamil, Telegu, and Urdu are all mother tongue languages. Most of the fifth grade students live in kutchas. There is no indoor plumbing in a kutchas, whatever water that is needed for cooking and cleaning is pumped into buckets, often by the hands of children. As indicated on the student questionnaire, most of the families cook their food over fire wood.

Although their dwellings are small, 80% of the fifth graders indicated that their families owned a television. Also, 98% of the students indicated that their families owned a cell phone, albeit a basic mobile phone solely for talking. However, 90% of the fifth graders have less than 25 books in their dwellings. Only 8% of the fifth graders indicated that their family owns a home computer. A bicycle was the most common form of wheeled transportation among the fifth graders' families as indicated by 72% of the students. The majority of the Komu Community student population is low socio-economic status. The population represents a mix of rural and urban locales, as some villages in the school's five kilometer radius are populated by a dozen or so people, whereas other villages are like small cities of 25,000 people. Most the students are the sons and daughters of farm workers, day laborers, and manual workers.

Interpretative Flexibility

As explained in earlier chapters, the SCOT notion of interpretative flexibility captures how a relevant social group's interprets the meaning for why they are using a certain technology. To identify the interpretative flexibility among Komu Community's teachers and students, I start this section with snapshots of the ways that the Komu Community fifth grade students used the school's laptops. The snapshots provide examples of the "curriculum in use" or how teachers and students designed learning experiences around the laptop.

Creating advertisements. Ms. Eshani begins the fifth grade ICT lesson by announcing it is a "practical lesson in PowerPoint." What she means by practical is that the fifth graders will be creating a document with Microsoft PowerPoint rather than just learning about a PowerPoint feature, which would be called a "theory lesson." When Ms. Eshani says "practical lesson" the fifth graders let out a buzz of excitement, they open their laptops, which are already on their desks, on click on the Microsoft PowerPoint icon. After the brief commotion, Ms. Eshani continues with her lesson, "Children, today you are going to make advertisements in PowerPoint. Tell me, children, what is advertisement?"

The fifth graders, whose desks are arranged in groups, begin talking to one another, but the students do not offer an answer. Ms. Eshani interrupts their caucusing and states, "Can no one tell me? Children, maybe you need clue? Would you like clue for advertisement?" The fifth graders call out, "Ma'am, yes, ma'am. Ma'am, please, ma'am." Ms. Eshani smiles and replies, "Okay, children, I give you clue. You find advertisements in paper." She then holds up a copy of the *Deccan Herald*, a popular English language newspaper in Bangalore. Several hands go into the air accompanied by shrieks of, "Ma'am, I know, ma'am! Ma'am, ma'am, pick me, ma'am!" Ms. Eshani points to a girl who is waving her hand. The girl exclaims, "Ma'am, advertisement is selling picture, ma'am." Ms. Eshani replies, "Yes, advertisement is picture in paper to sell you things—like this." Ms. Eshani points to an advertisement on the *Deccan Herald* front page. Then Ms. Eshani continues, "Today, I give you different advertisements. Then, you make advertisement with PowerPoint."

Ms. Eshani starts to distribute cut-outs of the newspaper advertisements. Each fifth grader gets an advertisement. As she is passing out the cut-outs, Ms. Eshani tells the students to re-create their advertisement on a PowerPoint slide. She lets the students know that they can

change the color of the text, but the advertisement design should be similar to the cut-out example. Ms. Eshani also tells the students that if they do not know what a word means on their advertisement cut-out to go to Google and search for the word or ask one of their group members. The fifth graders begin re-creating their advertisements.

I watch as a fifth grade boy re-creates an advertisement about Hewlett-Packard (HP) laptops that corresponds with a promotion during the Holi festival (Holi is an Indian holiday, celebrated during springtime, which often includes children throwing colored powder on each other). At the top of the PowerPoint slide, the boy inserts a Word Art text book that has a multi-colored font. The boy looks at the advertisement cutout that is next to his laptop and then begins to type, "Happy Holi from HP Computers."

The boy opens a new window and goes to Google Images. He types and searches for "laptops." The boy scrolls down a page of laptop images. He finds one he likes and copies the image using the laptop's mouse pad. Then, the boy clicks on his PowerPoint window and pastes the laptop picture on the PowerPoint slide. Using the laptop mouse pad, he moves the image over to left side. The boy clicks back on the Google Image window, selects another laptop image, copies it, and pastes this second laptop image on his PowerPoint slide. The boy slides the second laptop image directly underneath the first laptop image. The boy then looks down at the advertisement cut-out. He studies it. Then he goes back to the PowerPoint slide. He clicks on the "Text Box" icon. Using the mouse pad, the boy moves the textbox to right of the first laptop image. The boy clicks on the textbox and changes the background color of the textbox to red. He looks down at the advertisement cut-out and then begins to type in the red textbox a bullet point list of features of the laptop. On the final line of the textbox, he changes the font size, taps the caps lock key, and types, "BEST BUY: Rs 26,000 + TAX."

The boy picks up the advertisement cut-out, takes a few moments to compare the cut-out with what he has copied so far on the PowerPoint slide, and then puts the cut-out back on his desk next to the laptop. The boy creates another textbox on the PowerPoint slide; he colors this textbox yellow, and places the yellow textbox next to the second laptop image. The boy types in a bullet point list along with a "best buy" price in the textbox. He then saves his PowerPoint slide to a USB thumb drive. A couple days later, during the next ICT class time, the boy would present, what he called his, "Holi laptop advertisement."

Analysis of creating advertisements. This snapshot reveals a common use of the Komu Community laptops by the fifth graders. The students use their laptops to create and present PowerPoint documents. The snapshot depicts the meanings that the relevant social groups, especially the teachers, assign to the laptops. First, the laptops are practical. Not only is the laptop practical for copying and re-creating advertisements, but it is also practical for looking up the meaning of English words. Likewise, a second meaning, assigned to the laptops, is that the laptops provide a way to build and practice English vocabulary. The snapshot also shows a dominant pedagogy for learning English vocabulary: copying, or imitating, an artifact. However, although the fifth graders were copying (or re-creating) their cut-out advertisements, this practical exercise provided them with an opportunity to use a variety of PowerPoint features. For example, the activity might be practice for a future career in graphic arts. In snapshot's final sentence, I reveal a third interpretation of the laptops, particularly when creating documents in PowerPoint. Ms. Eshani, as well as the other Komu Community educators, believes the laptops are for presenting. Verbal presentation allows the students to gain confidence as they practice their English in front of an audience. The students verbally present just about everything they create on their laptops.

Presenting globish. Hanging on the wall space directly below the Smartboard in the Komu Community fifth grade classroom is a paper display of animals that one might see on an Indian safari. Words are written on each animal. For example, the words *celebrate* and *equal* are tattooed on a paper elephant. This display is titled, "Globish Words." Globish is a portmanteau, or blending, of the words *globe* and *English.* The school's vice-principal explained that globish words, like create and examine, are commonly used words in the English language that help prepare students to communicate in a globalized society. Each Komu Community classroom has a display of globish words and the students learn globish vocabulary along with English grammar. This snapshot captures a globish lesson for fifth graders.

Ms. Mamita writes four words on the white board: perish, performs, produces, protects. Then she tells her students to open their laptops and click on Microsoft Word to create a new document. The students follow her directions. Ms. Mamita then instructs the fifth graders to type the words that she listed on the board. Ms. Mamita points to each word and tells the students in the Kannada language what each word means. She then says in English, "Children, now on your laptops type a sentence in English after each word. Try to use pronouns in your sentences. Go to the Internet dictionary if you want to find out more about the word."

I observe a girl begin typing in her Word document. After the word, perish, the girl types: We should not perish our nature. The girl spaces down to the next word, performs, and types in: She performs dances. Then the girl opens a new window, goes to the Internet, and types dictionary.com in the address bar. Once dictionary.com opens, she types in the word, produces. For a brief moment, she scans the dictionary.com page and then turns to one of the members in her group. In the Kannada language, she asks what the word, produces, means. The group member replies to her inquiry in Kannada. Then the girl returns to her Word document

and begins to type: Cow produces milk. The girl then spaces to the last word in the list, protects, and types: Amma (mom) protects me.

Throughout this time, Ms. Mamita walks around the room and assists students with their sentences. When the students are finished typing, Ms. Mamita announces, "Children, now copy your sentences in your notebooks so that you can present your sentences to the class." The fifth graders take out a notebook and pencil from their desks. They begin copying their sentences into their notebooks. After about five minutes, Ms. Mamita inquires, "Who would like to present their sentences?" Almost all of the fifth graders hands go in the air along with cries of "ma'am, ma'am" to show their eagerness to volunteer.

Ms. Mamita chooses six students, including the girl I observed, to present. The fifth graders walk to the front of the classroom, stood in front of the Smartboard with their notebooks opened, and one by one began sharing their sentences. During their presentations, Ms. Mamita reminds the presenters to speak loudly and look at their classmates rather than looking too much into their notebooks. After each recitation, the rest of the class applauds. When all six finish, the class applauds again. Then Ms. Mamita states, "I will be listening throughout the day to see if you can use one of these words in a sentence." About an hour later, during the mathematics session, I hear a student call out, "Ma'am, ma'am, he perish my book!"

Analysis of presenting globish. This snapshot also reveals meanings for the Komu Community laptops. Like in the earlier snapshot about creating advertisements, the activity in this snapshot is about building an understanding of English vocabulary. Indeed, the students use their laptops to build their conceptual knowledge of "globish" vocabulary. Ms. Mamita's pedagogy helps to scaffold their understanding of these globish words as she first translates and explains what the word means in Kannada. Yet, the main activity is to practice using English in

multiple ways. The students type the vocabulary words, they use the globish words in sentences (albeit simple sentences), copy the words into their notebooks, and some students even present their sentences to the class. The laptops provide a way to facilitate this activity as the students are allowed to look up the words on the Internet for further clarification about meaning. Thus, the laptop is a tool for building their English vocabulary.

Teachers' interpretations. I interviewed the teachers separately. From their responses, all three teachers identified English language learning and presentations as the main purposes for the Komu Community laptops. The first interview question I asked was, "What two words or phrases do you think of when you hear the word computer?" The Komu Community teachers' responses were: "good for English presentation," "saves energy," "easy to create," "builds life skills," "needed for survival and success", and "secure future." Ms. Mamita responded with "good for English presentation" and during her interview, I followed up about what she meant. Her response captures how she understands the dual purposes for the Komu Community laptop, "Laptops help children learn English and presentation help children practice their English, so they can learn their English better." Ms. Mamita emphasized how the laptop is a tool for English language exposure and a tool for practice.

Before I delve deeper into the connection between the laptops being a tool for language exposure and a tool for practice, I note the other responses to the first question. I found their responses interesting because of the emphasis the teachers put on efficiency (i.e., saves energy), survival, success, and a secure future. Their phrases were reminders that the teachers are from the same villages as their students, where almost all work is done by hand with simple tools like a water bucket or a sickle to cut ragi. Furthermore, the teachers' responses seemed to reflect an appreciation for what is possible with a high-tech tool like a laptop computer.

When I started to inquire about the purpose of laptops for their students, the teachers focused their responses on the importance of the students using their laptops for English language exposure and for proficiency. For example, when I asked, "What do you understand as the purpose of using the laptops in school?" Ms. Eshani, the lead ICT teacher, responded with, "It helps their English. They enter English words in their laptops and present these words for the benefit of all children. English words help them operate their laptops. They create presentations to practice their English." Ms. Mamita also referenced English in her reply to the question, "The laptops motivate them to learn their English. They learn more English words when they use their laptops." In both Ms. Eshani's and Ms. Mamita's responses, they understood English as a significant part of operating and using computer technology. Indeed, both teachers equated "operating" and "using" the laptops to English language exposure and increasing vocabulary. The idea here is that once the students turn on the laptops they are immersed in a virtual world of English language.

The two teachers also expressed that learning English was about more than just using a laptop. Indeed, English represented the security of a future job. For example, this sentiment was shared by Mr. Tarun, the other ICT teacher, in his reply to the students' purposes for using the Komu Community laptops. Mr. Tarun remarked, "The laptops are a help for their English language. The laptops and English provide a secure job for them. Whatever field they may choose to study they need to know how to talk in English and use a computer."

The teachers interpreted that using the laptops for presentation purposes was another way the students practiced and developed their English vocabulary. Thus, the students' PowerPoint presentations were a tangible outcome for building their confidence with English. The students' constant creation of PowerPoint presentations was something that I was struck by

in my field observations. I probed this practice further in my interviews and asked, "I have noticed that the students create a lot of PowerPoint presentations, what is the purpose for making PowerPoint presentations?" Ms. Mamita explained that there are two purposes for the students work on PowerPoint. First, PowerPoint helped the students build their technical knowledge about the software. For example, students learned how to design a PowerPoint slide by using bullet points, inserting clipart, and including WordArt. Second, PowerPoint gave the students practice with communicating their ideas through a text based and verbal way.

Ms. Mamita identified that PowerPoint allows students to organize their communication, which is a key for students who are learning English. She said, "I want the children to organize and communicate what they are learning. The more the children communicate in English, the more confidence they will have with English. I tell them, the more you present the more confidence you will have in your English." This quote highlights how the teachers interpreted the students' use of PowerPoint presentations as congruent with main purpose for the laptops, which was to build English vocabulary.

Students' interpretations. In the student focus group interview and on their questionnaires, the students shared similar interpretations about the school's laptops. I conducted the focus group interview with eight fifth grade students. My first interview question was the same question from the teachers' interview, "What words or phrases do you think of when you hear the word computer?" The students responded in English with these associations: "English (repeated five times)," "PowerPoint (repeated four times)," "Google (repeated three times)" "games," "fast," "learning," and "whole world." I was curious about the words that the students repeated. Specifically, I wanted to find out why English, PowerPoint, and Google were repeated a couple of times.

I rephrased my next three questions to inquire about why students associated their laptops with English, PowerPoint, and Google. First, I asked about English, "Why English, why does the laptop make you think of English?" A girl replied, "Sir, laptops help us learn English. Laptops will help me speak English nicely." A different fifth grade girl interrupted and shared, "Sir, if I do not know English then I do not know how to use laptop. English and the laptop help me find a good job." Like their teachers' interpretation, the students had a strong association with the laptops helping to improve their English or as the first girl put it, "to speak English nicely." The students also communicated that English was part of operating a laptop and if they do not know English, then they will not know how to use a laptop. Conversely, the students emphasized how using their laptops was part of their English language development.

Second, I also followed up about why PowerPoint was repeated four times. A boy in the focus group explained, "Sir, we learn English with PowerPoint. We like PowerPoint. We enjoy it because we can include pictures with the English words." A girl in the focus group added, "We show the PowerPoint to the class. We speak in English when we show PowerPoint." What theses students were communicating is how the PowerPoint gave them a chance to practice English. The PowerPoint represents activity based learning. Like the first snapshot illustrated, when creating their PowerPoint slides, the Komu Community student are actively using English vocabulary. They are matching pictures to text. Thus, the PowerPoint provides a tool for understanding English vocabulary, a tool for providing a contextual meaning to English words. In their creation of PowerPoint presentations, the students developed a deeper understanding of English vocabulary by including images with the vocabulary. Likewise, the students' verbal presentations provided great practice for communicating in English.

Third, Google was another word that the students repeated. I followed up on why. The students shared how Google helped them to search for information and the meaning of English words. The students explained that they used Google to find images that corresponded to the English vocabulary words they were learning. A girl in the focus group explained the importance of Google in this way, "Google shows pictures of words. This is a help to speaking English." The Komu Community students identified how they searched Google as a way to build their conceptual understanding of English vocabulary. Like the old adage that a picture is worth a thousand words, the Komu Community students would often start to build this vocabulary by searching on Google Images in order to get a picture of the word. In the focus group, one of the boy students shared why he liked Google Images, "I find information about English words by looking at the pictures on Google. The pictures are a help to know what the English words mean."

Summary. In sum, like the teachers' interpretations of the laptops, the Komu Community students identified that the laptop's primary purpose was for learning English. For both groups, PowerPoint presentations provide a way to practice English language through design and presentation. Google was understood as a dynamic tool that allows the students to build conceptual knowledge of English vocabulary. For example, the students explained how they understood the questionnaire's category of "searching for information" as equivalent to searching Google for information about English vocabulary words. Ms. Mamita also confirmed that Google was most likely what most of the students associated with "searching for information." Both the teachers and students communicated that English was the most important technical skill for operating the laptops. While PowerPoint and Google help the students to practice and build upon their English language development, English proficiency is the end goal.

Stabilization

At Komu Community, then, the teachers and fifth grade students interpret the school's laptops as a way to build English language proficiency. The teachers dominated the meaning making for the school's laptops, but the teachers were also dominated by the Komu Community administrators' vision for the school's one-laptop-per-child program. The stabilization of the Komu Community laptops starts with school's administration. Specifically, Mr. Chitesh, the school's principal, and Ms. Risha, the school's vice-principal, dominate the interpretations of the purposes for the laptops at Komu Community School in two ways. First, Mr. Chitesh and Ms. Risha communicate the Komu Community vision for the school's one-to-one laptop program to the teachers and larger community. Second, the administrators train and support the teachers in how the students should use the laptops during the school day.

In many ways, Mr. Chitesh is the originator of Komu Community School. Mr. Chitesh was a long-time secondary school teacher and administrator at Aadu International. The idea for Komu Community School emerged in 2008 during a professional development workshop that Mr. Chitesh presented for Aadu International School staff. The theme of Mr. Chitesh's workshop was "social entrepreneurship," which he defined as, "taking risks and investing in and education that benefits and helps to transform the larger community."

Mr. Chitesh explained that during his social entrepreneurship workshop, he wanted to rouse the Aadu International School community into doing some kind of community action project that would benefit the villages surrounding the Aadu International campus. It happened that the Aadu International School chief executive officer (CEO) attended Mr. Chitesh's workshop. The CEO was inspired and talked with Mr. Chitesh about the idea of creating a community school for children in the villages that surrounded Aadu International. Under the

leadership of Mr. Chitesh, and with the support of Aadu International School, Komu Community School was founded and built by June 2010. In less than two years from Mr. Chitesh's workshop on social entrepreneurship, Komu Community opened its door to hundreds of village children living within a five kilometer radius of the school.

In their interviews, Mr. Chitesh and Ms. Risha referred to the school's unique vision. For example, when I asked about the school's laptop program, each one explained how the laptops are one facet of the school's overall vision statement, which states: "To adopt an integrated approach to learning, with emphasis on empowering students through leadership competencies, proficiency in English, the power of technology, and a strong sense of their communities." The administrators recognized the laptops were part of a deeper commitment to providing an education that connected children to their villages while also preparing the children for future success in a globalized India. Mr. Chitesh put it this way, "We are a unique school. Of course, there are rich school models for rich people. And there are schooling models for educating poor people. But, it is very rare to see a rich school model for poor people." Mr. Chitesh explained that what he meant by that statement was that Komu Community adopted some of the best practices of Aadu International School, like inquiry-based strategies for learning, and applied those practices to the context of a community school. So the investment in the one-laptop-per-child program was an example of "rich school model for poor people." But such an investment was one component, among many, in providing a quality education.

Mr. Chitesh defined quality education as an "education for life." Ms. Risha explained how a quality education empowers children with confidence and self-esteem. According to Ms. Risha, the Komu Community children receive a comprehensive education, one that prepares them with English and technology skills, but, even more importantly; it is an education that

imparts dignity, equality, and self-worth. Ms. Risha summed up her beliefs about quality education by explaining that, "Our children might have been born to poor families, but that is not their mistake. That is not their karma. They are children, like any other children in the world. The goal here at Komu Community School is to get the children to believe it." The school's commitment to English language learning and to their laptop program are both means to realizing the end goal of a quality education that includes emancipation.

Two practical skills. Out of the larger goal of "delivering a quality education," the administrators identified two important skills that Komu Community was preparing its students with: (1) proficiency in the English language and (2) the ability to operate computer applications. The administrators believed that these two skills worked in tandem. Mr. Chitesh explained that there was an incentive for the students to learn English since the laptops' Windows based operating system was also in English. Because the students desire to use their laptops, they also are compelled to learn a basic level of English to operate the laptops. Mr. Chitesh further stated that, "Komu Community School has proven that English language learning and technology skills can develop together." He identified that it is the child's curiosity that makes this happen.

As Mr. Chitesh discussed the importance of curiosity, he referenced Mitra's (2002) "Hole in the Wall" project and explained how many of the Komu Community students arrived on school's first day like the children from the "Hole in the Wall." The students had almost no exposure to computers and could only understand a handful of English words. Yet, after only a couple hours of using the laptop, many of the students figured out how to use the laptop's mouse pad as well as click on links to the Internet and several computer applications. Mr. Chitesh commented how he noticed that once students overcame their fear of touching the laptops, they

quickly became interested in learning how to operate the laptops. Together, curiosity and interest in the laptops motivates the students to learn English.

The administrators also identified the importance of Komu Community students mastering the skill of being technologically literate with a computer. By technological literacy, I mean the ability of the students to confidently operate computer applications like Microsoft Word, Microsoft PowerPoint, and, even, the Google search engine. Both administrators posited that the skill of operating computer applications was something that has *immediate* and *lasting* benefits for their students. An immediate benefit is increased confidence. When the Komu Community children were given a school laptop, Ms. Risha explained that this act removed the "fear of technology off their minds." She reported that the children at Komu Community are no longer afraid to turn on a laptop or worry about breaking the laptops just because they touched it. The skill of operating computer technology starts with being confident and comfortable with computer technology.

The lasting benefit of technological literacy is future success. Mr. Chitesh talked about this benefit as part a package of "life skills" that the students needed success in school and their future careers. Mr. Chitesh identified that "life skills" included the skills of operating a computer, searching for information with a computer, and presenting information with a computer. Mr. Chitesh explained that he often imagined 10 to 15 years in the future when Komu Community students were on the job market. The students' likelihood of landing a good job (i.e., a middle-class job) would increases significantly when they show that they can operate a computer and present in English. Thus, the PowerPoint presentations that the fifth grade students created and presented to their peers were an important part of their development for future success.

Administrators as an accessory social group. I have been building a case for the role that "accessory social groups" have in shaping the meaning-making for computer technology in schools. As I stated earlier, an accessory social group has a high degree of influence in the social construction of a technology even though the group has a low level of inclusion into the actual uses for the technology. Thus, the accessory social groups bring a certain degree of "rhetorical stability" (Bijker, 2010) to a technology's social construction. By rhetorical stability, I mean the stabilization of a technology based on a social group's verbal descriptions about the technology rather than their uses for the technology.

The Komu Community administrators are an example of an accessory social group. While Mr. Chitesh and Ms. Risha are not involved in the day-to-day uses of the school's laptops, they do have a considerable amount of influence on meanings for the laptop. The administrators' vision of "delivering a quality education" through practical skills like English language learning and presenting PowerPoints dominates how the Komu Community teachers and students use the laptops. Specifically, the administrators believe that the student use of the laptops is both emancipatory and pragmatic. In discussing emancipation, I follow Friere's (1970, 2005) notions of an emancipatory education, which is an education that liberates; an education which helps learners to be conscience of who they are and ways to change social structures. The Komu Community administrators understood that the students' use of the laptops was, in part, an act of emancipation. The laptops symbolized the "ticket to a better life," as Mr. Chitesh called it, and a way to have access into India's middle class. Such interpretations for the laptops were part of Komu Community's vision to liberate students with the "power of technology." Yet, the administrators' interpretations were quite pragmatic in that they have identified two skills, English language learning and operating computer applications, as the most practical for the

students' future education and career. Like the snapshots help illustrate, the ICT teachers designed the laptop activities to be as pragmatic as possible for the students.

Technological Frame

Komu Community School adds another layer to the Bangalore Challenge. It is a Bangalore-based school that seeks to prepare village students with knowledge of their community and knowledge of the world. It is a school for equal opportunity. Even though Komu Community might not be recognized as a school that would be the measure for success in the twenty-first century, it is school that does get noticed, especially by the local villagers who live within the school's five kilometer radius. One reason it gets noticed is because of Komu Community's technological frame that aims to empower students, who are mostly in the lower class, with technology skills.

One way to investigate the Komu Community technological frame is through the SES. Certainly, Komu Community provides a compelling narrative regarding SES. The Komu Community participants had a refined interpretation for the laptops. This interpretation was captured by the school's vision statement, which was posted in every building and classroom at Komu Community: "To adopt an integrated approach to learning, with emphasis on empowering students through leadership competencies, proficiency in English, the power of technology, and a strong sense of their communities." In keeping with this vision statement, the laptops are a tool of empowerment.

Indeed, the laptops are part of the school's integrated approach to learning, which empowers students to become technically-savvy, English proficient leaders that still care about their villages. Such empowerment paves the way to the Indian middle class via tech skills and English proficiency. The logic for the Komu Community laptops is organized thusly: (1) Komu

Community fifth grade students, who are lower SES, use their laptops for creating and presenting artifacts in English; (2) By creating and presenting artifacts, the Komu Community students become proficient in the English language; (3) English language proficiency is empowering and, coupled with technology skills, provides an entry way into India's middle class; so (4) Therefore, the Komu Community laptops are part of empowering the Komu Community students to gain access to India's middle class. In Chapter 8, cross-case analysis chapter, I examine whether this is the only narrative regarding Komu Community's technological frame.

CHAPTER 8

CROSS-CASE ANALYSIS

This chapter's purpose is to report on the dissertation's two main research questions: How and why is computer technology socially constructed in Bangalore's elementary schools? How does the social construction of technology compare across schools? The four case studies presented in the earlier chapters provide narrative examples of the social construction of technology in Bangalore's elementary schools. While these narratives share similar themes, the narratives cannot be reduced to a single theme. Indeed, the malleability of computer technology is a finding across the case study schools. By malleability, I mean the many ways that people shape and reshape the meanings for computer technology based on several factors like social context and negotiations with other people (Bijker, 1995; Feenberg, 1991).

The cross-case analysis examines themes related to technology's social construction through a comparison of the case study schools. I start by anchoring the chapter in a table (see Table 6) that summarizes the findings from the four case studies. The table's headers correspond with SCOT's themes of: (a) relevant social groups' social context and demographics; (b) interpretative flexibility; (c) stabilization; and (d) technological frame. The order of the SCOT themes aligns with dissertation's four research sub-questions: (1) What are the demographics characteristics of the relevant social groups in fifth grade classrooms in Bangalore? (2) What interpretations do the relevant social groups assign to computer technology? (3) How are the interpretations for computer technology stabilized? (4) How do the social groups' demographic characteristics help explain the meaning they assign to computer technology use? Table 6 presents a summary of findings, organized across schools that are arranged by the SCOT themes, which correspond to the dissertation's four research sub-questions.

Table 6

Summary of Each School's Findings Organized by Research Sub-question Themes

	SCOT Themes			
Schools	1) Context / Demographics	2) Interpretative Flexibility	3) Stabilization	4) Technological Frame
Jinka Public *"One laptop school"*	Rural Bangalore Village school Students are barefoot, no shoes	Laptop is used for "basic skills" like typing and learning English vocabulary words	*Dominated* by the donor org., the SSA Foundation	Lower SES Laptop is entry into India's middle class
Komu Community *"Equal opportunity school"*	Sub-rural Bangalore Community school Students wear oversized shoes with holes	Laptops are for developing English proficiency and "life skills" by creating and presenting artifacts	*Dominated* by the school's administration and school's vision	Lower SES Laptops are entry into India's middle class
Bara National *"Computers for logic & coding"*	Urban Bangalore Private school Students wear polished black or brown business shoes	The computer lab is for developing the logic needed for "programming skills" and coding software	*Dominated* by the school's computer science teachers	Middle SES Computers help secure a middle class, technology related job
Aadu International *"Creativity & curiosity are cousins"*	Suburban Bangalore Private school Students wear Nikes and Skechers shoes	Laptops and the computer lab are for developing "research skills" and enhancing presentations	*Consensus* among the school's teachers and students	Upper SES Computers help foster leadership and entrepreneurship

The Thesis

Table 6 is the chapter's summative graphic organizer. I analyze and compare the themes that emerged from the four case study schools based on the Table 6 findings. These findings are part of the chapter's thesis. In addressing the aforementioned research questions, I argue a multi-faceted thesis: (a) Taken together, the case studies show computer technology's malleability across Bangalore's elementary schools; (b) However, given the paradox of malleability, within each school the meanings for computer technology became obdurate (or fixed) in relationship to the curriculum, pedagogical practices, the school's ethos, the school's social context, and the socio-economic status (SES) of the student body; (c) Additionally, the influence of accessory social groups stabilized and often dominated the meaning making for each school's computer technology; (d) Stabilization, though, occurs within a school's technological frame; each school's technological frame is a reflection of Bangalore's wider sociotechnical context. Put simply, there are many different meanings for computer technology, but in specific settings, like schools, social groups negotiate one or two meanings that become fixed according to the school's context. These fixed meanings often reflect the wider social factors of a society.

I proceed with a caveat about answering the dissertation's primary research questions. I recognize the tension in research (and in the thesis I statement I just wrote) towards causation. Throughout this chapter's analysis, though, I seek to avoid making causal claims about technology's social construction being related to one or two social factors at each school. The "generative promise" of this analysis is in comparing and clarifying the complexity that is part of technology's social construction in elementary schools (Peshkin, 1993). While I parse out and order the thesis for purposes of lucidity, in reality, this thesis is full of complexity and non-linearity. Indeed, the social construction of technology in schools involves a combination of

meanings, uses, and stabilization of computer technology in concert with several social groups who are relationship in educative and political ways. So not only is technology's social construction complex, non-linear, it is also messy (Law, 2004).

I organize the messiness through what I call an "hourglass analysis." I start the hourglass analysis with an examination of technology's malleability as a broad theme across all schools; then I narrow in on technology's obduracy with the cases; I broaden again by analyzing technology's stabilization across the school; and, I finish with a wider analysis of each school's technological frame in relationship to Bangalore's wider sociotechnical context. Thus, an "hourglass analysis" of technology's social construction starts with the wider context, narrows in on the shaping of technology's meanings within specific case settings, and then expands to the purposes of these meanings in the wider context. Figure 3 provides a graphic representation of the "hourglass analysis" that I use to structure the chapter's cross-case comparisons.

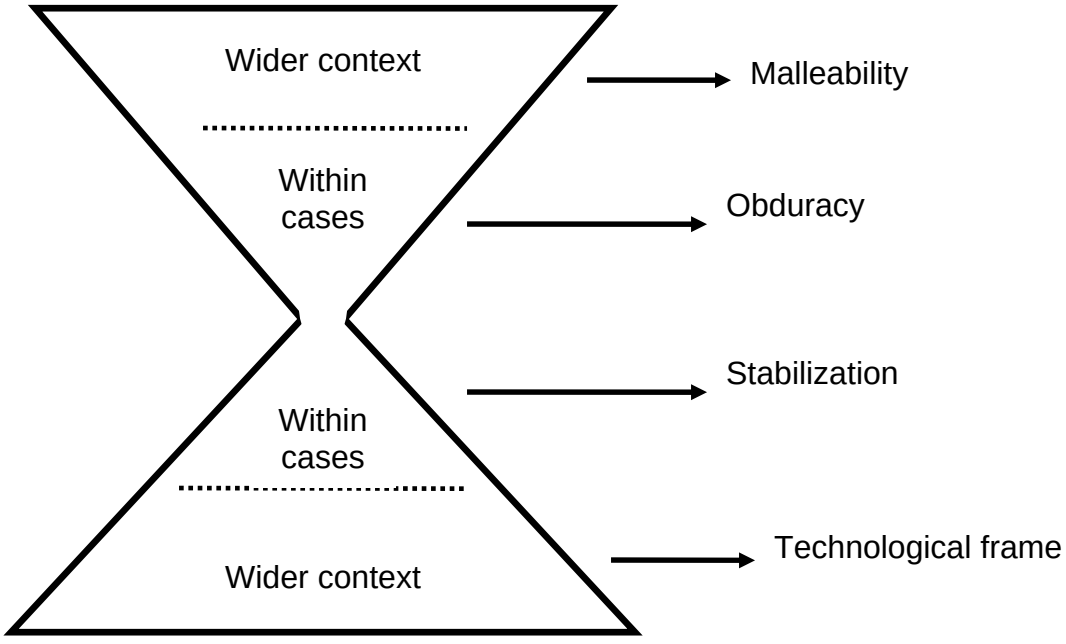

Figure 3. The hourglass analysis of the social construction of technology.

Malleability. Malleability provides the foundation for SCOT as it suggests that there are a plethora of meanings for computer technology and these meanings are constructed by social groups who are *interacting in* and *making sense of* society writ large. Malleability is also the sum of the social groups' interpretative flexibility as malleability refers to all the possible meanings for computer technology. I discuss the malleability of computer technology across case study schools by investigating each school's weekly schedule. The weekly schedules shed light on the curricular emphases that influenced the ways that students used computer technology. In particular, I examine each school's curricular focus in terms of subject matter given the most amount of weekly time. I contend that the differences in mode of subject matter time show examples of the malleability of meanings for computer technology across the four schools. I use Table 7 to present these findings. Table 7 shows the subject matter that was scheduled with highest percentage of time and the most minutes of instructional time per week.

Table 7

Each School's Weekly Mode of Subject Matter Time

School	Subject Matter Mode	Subject Minutes/Total Minutes Per Week	Percentage of Weekly Time
Jinka Public	Math	270 minutes/1500 minutes	18%
Komu Community	English	320 minutes/1000 minutes	32%
Bara National	Math	360 minutes/1800 minutes	20%
Aadu International	Unit of Inquiry	495 minutes/1600 minutes	31%

Table 7 provides comparisons about each school's weekly schedule. Although Table 7 does not capture data regarding the quality of instruction in these subject matter areas, it does describe what subject matter each school spent the most amount of its week covering. Again, I reference this table to compare how a social factor like a school's weekly schedule relates to the meanings that the social groups, especially the teachers, assign to computer technology. I begin with the clarification that the total amount of minutes per week does not include break times or lunch periods. Of all the study's students, the Bara National fifth graders spent the most amount of time in school at 1800 minutes (30 hours) per week. By comparison, the Bara National fifth graders' weekly schedule was more than 12% longer than the Aadu International fifth graders, 20% longer than Jinka Public, and 80% longer than Komu Community fifth grade schedule. These 1800 minutes did not include the extra time that the Bara National students occasionally spent during a Saturday morning school session, I omitted these data because the Saturday school timings were irregular and happened only during the formal testing periods.

In keeping with Bara National's emphasis on developing logical ways of thinking, 20% of the fifth grader's weekly schedule was dedicated to mathematics. Like I explained in the case study chapter on Bara National (Chapter 4), logical thinking was one foci of Bara National's mathematics curriculum. In many ways, the computer science period was an extension of that logic. Ms. Janisha, Bara National's lead computer science teacher, said as much when she explained how the computer science class was a "reinforcement of the logic the children learn in mathematics." Bara National's priority on mathematics shapes, in part, the computer science teachers' interpretations for the school's computer technology.

In contrast, Komu Community students spent the least amount of time in school. However, of all the schools, Komu Community spent the most minutes—320 minutes per

week—learning English as a specific, language arts type subject matter. Komu Community's total minutes of weekly time on English was only around 12% less than the total number of minutes the Bara National fifth graders spent in their weekly mathematics classes (360 minutes), even though Komu Community fifth graders attend school 800 less minutes each week compared with the Bara National students. The large disparity in weekly time is a reflection of Komu Community's two shift schedule, which I discussed in Chapter 7. However, whether the Komu Community fifth graders attended the morning or afternoon shift the emphasis on English language proficiency was the same. The Komu Community educators explained that the amount of weekly instructional time given to English as a specific subject matter was meant to immerse their students in the English language. Mr. Chitesh, the Komu Community principal, illuminated that relationship when he stated that, "The children should see a connection between knowing English and working with their laptops. Both are going to land them a job and both are a means to survival."

At Aadu International, the subject matter emphases and weekly schedule were quite different. Aadu International's fifth graders spent more than a third of their weekly schedule engaged in their Unit of Inquiry. The Unit of Inquiry is the terminology that the International Baccalaureate curriculum uses to designate the students' investigation of a transdisciplinary theme that is usually science and social studies focused. At Aadu International, the Unit of Inquiry time is where the fifth graders sharpen their research skills by collecting information on the unit questions and ideas they are interested in exploring. Additionally, near the end of each Unit of Inquiry, students worked on unit projects that showcase what they learned throughout the unit. Throughout the Unit of Inquiry time, students used the school's laptops and computer lab to support their investigations. Thus, the 31% of Unit of Inquiry time mirrors the interpretations

and meanings that the teachers assigned to computer technology. Ms. Darsha, the lead fifth grade teacher at Aadu International, explanation of computer technology's main purpose captures a telling example, "The students use the computers to conduct their own research related to their inquiries. The computers are devices for their research and thinking. We want them to process that research and use the computers to prepare it for presentation."

Jinka Public was different from the three aforementioned schools. While mathematics was the subject matter that was given the most weekly instructional time, the Jinka Public students' main purpose for the school's laptop was to type English vocabulary words (see interpretative flexibility column in Table 6). However, since there was only one laptop, the Jinka Public students completed their English language activities on their own time. Jinka Public's emphasis on math (which is taught in Kannada language) seemed to be related to the school's alignment to India's National Curriculum Framework (discussed in Chapter 1), which mandates a higher percentage of instructional time be reserved for mathematics. While Jinka Public students do not practice mathematics on the school's laptop, Jinka Public does schedule almost the same percentage weekly time for mathematics (18%) as Bara National (20%).

My purpose for comparing each school's weekly schedule is to show quantifiable examples for computer technology's malleability in the wider context of Bangalore's elementary schools. For example, in three of the four cases, the uses for the school's computer technology were related to the subject matter area that was scheduled for the highest percentage of weekly time. Both Komu Community and Aadu International integrated computer technology throughout their respective curricula. Given their commitment to integration, it follows that the teachers and students would associate the meanings for computer technology with the subject matter area in which they used that technology the most. Thus, one might expect there to be a

relationship between subject matter and computer technology uses. However, at Bara National the computer technology was not integrated throughout the curriculum. Rather, the school's computer technology was its own subject matter area (i.e., Computer Science). Yet, the computer science teachers interpreted that the computer science periods were an extension of the logic students learned in their mathematics class periods. Hence, mathematical logic was part of the Bara National computer science teachers' (and by proxy their students) interpretations for the meanings and uses of computer technology. Whereas, at Komu Community, English language proficiency shaped the meanings and uses for the computer technology; while at Aadu International it was inquiry and research of transdisciplinary unit topics.

Discussion. Malleability provides the starting point for addressing the dissertation's first research question: How and why is computer technology socially constructed in Bangalore's elementary schools? Bijker (1995) identifies that malleability allows for the possibility of choices to be made about technology and these choices represent the "bundle of meanings about what computer technology can be used for" (p. 281). Indeed, within the context of Bangalore there are many "bundles of meaning" that actors can assign to computer technology. Put another way, each "meaning bundle" represents a narrative about the possibilities of computer technology. As Table 6 details, Jinka Public's meaning bundle surrounds English vocabulary building; while Komu Community's meaning bundle for computer technology connects to English proficiency; Bara National's meaning bundle centers on developing logic for programming; whereas Aadu International's meaning bundle for computer technology relates to research and inquiry.

The first point of my thesis, then, is that the meanings for computer technology in Bangalore's elementary schools are malleable. Across the case studies, there was not one exact

meaning for computer technology that all four schools shared in common. Even in the schools that had a relationship with each other, like Aadu International and Komu Community, and were separated by less than kilometer's distance, the meanings for computer technology were different. Rather, each school's social groups assigned meaning to computers in ways that connected with the school's unique curricular emphases. While malleability is a helpful starting point for analyzing how and why computer technology is socially constructed, it is important to note that malleability is not boundless. Indeed, there are constraints to malleability's "bundles of meaning." In Table 7's description of weekly schedules, the case of Jinka Public provides an example of constraints. Since the school has only one laptop, there is a resource constraint. There are only a certain number of students who can use the laptop at one time. There are also constraints related to laptop's hardware, which is not as accessible in the students' native language (or script). These constraints shape the meanings and uses for computer technology.

Paradox of malleability. Although computer technology's malleability offers many "bundles of meaning," the paradox of malleability is that when social groups, in a specific setting, interact they narrow in one or two meaning bundles so that a computer technology's meaning becomes quite fixed. SCOT theorists identify the paradox of malleability as how computer technology's meaning goes from malleability to obduracy (Bijker, 1995). Obduracy, SCOT theorists explain, is the way in which a meaning for computer technology becomes so fixed (or hardened) that the meaning shapes the network of practices, rhetoric, and beliefs among social groups in specific setting (Bijker, Hughes, & Pinch, 1989). To answer the dissertation's primary research question, in this section I focus on describing and comparing *how* computer technology was social constructed across the four schools. I examine three themes that capture the obduracy

of meaning for computer technology within each case study school. The three themes are: (1) skill development, (2) technological artifacts, and (3) the educators' notions of confidence.

Skill development. In all four case study schools there was an agreement that computer technology was useful for developing skills, but each school's educators identified a different set of skills. In each case study chapter, I presented two "snapshots" of the predominant ways that the students used their school's computer technology. The snapshots captured the curriculum-in-use and the skills that each school's educators believed were important. The educators specifically referenced these skills in their interviews. On Table 6, I put quotes around the phrases that the educators repeatedly used to define computer technology skills. At Jinka Public, the educators talked about their students using the school's laptop to develop "basic skills." At Komu Community, "life skills" were the focus. At Bara National, the computer science teachers emphasized "programming skills;" whereas at Aadu International, "research skills" were stressed.

A closer examination of these phrases reveals the obduracy of interpretations for computer technology at each school. Indeed, factors like the school's social context, the school's SES, and the educators' pedagogical beliefs about computer technology all reinforced the obduracy that the different skill sets represented. For example, at Jinka Public School, the village school located in the rural part of Bangalore, the educators discussed the importance of students developing "basic skills" on the school's laptop. For the Jinka Public educators, basic skills meant their students would learn how to type in English. The fifth grade teachers at Jinka Public explained how typing on the laptop helped students practice English vocabulary. Mr. Amit, the CEO of the SSA Foundation that donated the school's laptop, stated it this way, "The laptop is useful for building basic skills in English." Why basic skills in English? Both the students and teachers at Jinka Public explained that learning English was the key to "a better

life" and more opportunity. The laptop's meaning became fixed or obdurate on helping student gain basic skill (i.e., typing English vocabulary) to gain access to a better life.

A somewhat similar narrative unfolded at Komu Community; however, the Komu Community educators talked about the students developing "life skills." Like the Jinka Public students, the Komu Community students represent India's lower SES. However, Komu Community had laptops for all its students so it was not constrained by a lack of resources like Jinka Public. The Komu Community's administrators believed that the laptops help develop "life skills." They identified life skills as: (a) operating a computer, (b) searching for information with a computer, and (c) presenting information in English with the aid of a computer. The Komu Community teachers indentified that life skills included knowing how to use software programs like Microsoft Word, Microsoft PowerPoint, and how to use Google to find information. Ms. Mamita, the school's fifth grade teacher, explained how such skills made the children "ready for the future." At Komu Community, the educators connected life skills to the school's vision of empowering student with English proficiency and technical capabilities. Such skills would, as Mr. Chitesh, the school's principal, stated, "Insure the students a ticket to a good job and a quality life." Thus, preparing the students to become English proficient and skilled at operating computer technology defined the obduracy of the Komu Community laptops.

At Bara National, there was also a focus on skill development for the future. Yet, unlike the Komu Community, the Bara National computer science teachers pinpointed that the future, for most of the Bara National students, would be in software engineering or computer programming: the kind of middle class job that many of the students' parents also made a career of in Bangalore's computer technology industry. The obduracy of meaning for the Bara National computer technology was fixed on reproducing "programming skills." Ms. Janisha, the lead

computer science teacher, explained these skills the following way, "Our curriculum is a journey of learning programming skills on the computer. At the younger level, this means learning to use the computer to solve simple problems and learning to think logically." Why programming skills? Again, Ms. Janisha summed it up best by explaining how 80% of the Bara National graduates go into a computer programming field, so the curriculum is designed around programming skills in order to prepare the students for their future work as programmers.

While Komu Community and Bara National focused on developing skills for future jobs and careers, skill development at Aadu International focused on skills that students would use in their schoolwork. The Aadu International teachers stressed the importance of using the school's computer technology for "research skills." They explained how "research skills" helped the Aadu International students successfully navigate the school's IB curriculum. Mr. Bibin, one of the Aadu International fifth grade homeroom teachers, explained that, "Research skills are part of idea ownership. We want our students to formulate their own ideas in their inquiries. And we also expect them to cite where their ideas came from by giving proper given proper credit to sources." The teachers' focus on developing research skills was not only connected to the IB curriculum, it was also part of the notion of owning ideas. For Aadu International students, most of whom were upper SES, ownership was likely to be a familiar concept. Whether it was intellectual property or businesses, many of their parents were owners of brands and ideas. The Aadu International teachers framed research skills around idea ownership as one demarcation of the obduracy of the school's computer technology.

Artifacts. Technological artifacts reflected each school's different emphases on skill development. The artifacts provide further evidence for the paradox of malleability. I will explain by examining word processing software artifacts. The Jinka Public students used a

program called Writer, an Open Office version of Microsoft Word. In keeping with the school's focus on developing "basic skills," the Jinka Public students used Writer primarily for listing English vocabulary words. Specifically, the students created two columns and typed in English antonyms on either side of the column. The Komu Community students used Microsoft Word for their word processor. The students' word processing activity involved typing in the definitions to globish words, which are commonly used words in the English language. Like Jinka Public, this exercise provided the Komu Community students practice with typing in English. However, in keeping with the school's emphasis on "life skills," the Komu Community students went beyond listing words, they also defined each globish word and created a sentence with each word.

The Bara National students also used Microsoft Word in their computer science time. Their purpose for using Microsoft Word was not for the purpose of learning English, but, instead, they developed their "programming skills" by systematically practicing Word's formatting applications. Specifically, the Bara National students changed the font size and color of text, organized text using bullet points and numbered lists, and used word art within a textbox. These were some of the Word formatting skills that were formally assessed by the Bara National computer science teachers. Aadu International students used Microsoft Word primarily for essay writing. As part of their Unit of Inquiry, students would type essays about questions that they explored in their research. The Aadu International fifth grade teachers explained to the students how the essays reflected the synthesis component of the research cycle. Microsoft Word was a tool to assist the Aadu International students in composing and presenting their synthesis of research. The essay was the outcome of their "research skills."

These brief descriptions of word processing artifacts illustrate that while all fifth grade students across the four schools used word processing software their purposes for doing so were quite different. For example, at Jinka Public and Komu Community, the students used the word processing software to practice English. While the Komu Community English language activities provided a deeper context for understanding English vocabulary, both schools engaged their students in activities that would increase their exposure to English language. Might one observe Bara National students doing similar English language activities on their school's computer technology? No, not at all, the Bara National children knew conversational English; the medium of their instruction was English, so the Bara National students would consider any computer-based, English language activities dull and pointless. The Bara National students' purpose for word processing was to build their computer programming skill set. The computer science teachers sequenced the formatting activities in order to, as Ms. Vitna put it, "show the computer's logic and have the children format in steps because that is what computer programmers do." While at Aadu International, the purpose for word processing was to synthesize and present research. The essay was the product of "research skills" and provided a professional way for the students to present and own their ideas.

Notions of confidence. Confidence was a word that all the schools' educators referenced and repeated in their individual interviews. Across schools, I found that words and phrases associated with confidence kept being repeated. For example, the educators talked about the importance of students "feeling confident," "not feeling afraid to touch the computer," and "not having any doubts about operating the laptops." Yet, while the educators might have shared a similar language for expressing the purposes of computer technology, their notions for a word, like confidence, were quite different school by school. The Jinka Public educators talked about

confidence in two ways. First, confidence meant overcoming the fear of touching the school's laptop. While this might seem trivial, it was quite important to the Jinka Public teachers and to Mr. Amit, the SSA Foundation's CEO. The Jinka Public educators explained how their students were very afraid to touch the school's laptop because they thought they might break it. To help the students overcome this fear, Mr. Amit suggested that the teachers assign one student as the *laptop magu* or laptop captain to take care of the laptop. Mr. Amit's rationale was that once the other Jinka Public students saw the laptop in the hands of a fellow student that would help to ease any feelings of anxiety about damaging the laptop. In keeping with theme of obduracy of computer technology at Jinka Public, the Jinka Public educators also shared how the laptop helped the students develop confidence in their English language comprehension. Rather than gaining confidence through overcoming a fear, this second notion of confidence was more about the students expanding their English language vocabulary.

The Komu Community educators shared similar interpretations about confidence. For example, the Komu Community administrators explained how confidence meant "taking the fear of technology off the child's mind." This was similar to the Jinka Public notion of overcoming fears as a source of confidence. However, the Komu Community administrators would use the word "risk-takers" to describe how the Komu Community students were no longer afraid of the technology and, in fact, were willing to take risks. One of the risks the students took was giving presentations in English. The Komu Community teachers explained how such risks were the way the students "gained confidence as they practice their English in front of an audience." While both the Jinka Public and Komu Community educators shared similar notions of confidence, they interpreted confidence according to a particular understanding about their students' English language development. The Jinka Public educators' interpretation of

confidence was at an introductory level of English where students practiced and replicated English vocabulary words. However, the interpretation at Komu Community was a more advanced level of English where students practice using English language through presentation and typing English words in original sentences.

The Bara National computer science teachers shared the notion of confidence as overcoming fears. This was captured by Ms. Sanchana, a fifth grade computer science teacher, who stated, "I believe that children should not be scared to use the computer. We teach them confidence. The child should see that using a computer is the same as using his fingers to learn." Yet, in keeping with their meaning obduracy for computer technology, the Bara National computer science teachers interpreted confidence with developing "programming skills" necessary for operating all the computer's functions. This is what Ms. Vitna meant when she asserted that, "We teach the students to use the whole keyboard and all the keyboard commands, so that they will not have any doubts about the computer." For the Bara National computer science teachers, "not having any doubts" meant that their students understood the computer's logic and were deft at using all parts of a keyboard since these were essential skills for coding and programming software.

In contrast to the other schools, the Aadu International educators spoke the least about the purpose of technology for developing students' confidence. They communicated their notion about confidence as a concern about their students "over-confidence" with computer technology. For example, Mr. Bibin explained, "My students think that they know how to do everything with a computer. Sometimes I worry that they have too much confidence." However, almost immediately after raising the concern about over-confidence, Mr. Bibin shared an example of observing an Aadu International student who was attempting to add a transition to text on a

PowerPoint presentation. While practicing the presentation, the student realized that the transition was not working. Rather than giving up or go to Mr. Bibin for help; this student corrected the mistake by using the PowerPoint help feature. Mr. Bibin shared how this was example of confidence as "self-correction" by "knowing when a mistake has been made." Such confidence was not about being skilled as much as it was about habits of self-reliance and independent thinking.

Discussion. In this section, I examined and compared three themes that shed light on the obduracy of meaning about computer technology in each case study school. The purpose was to show evidence for the second statement in my thesis that within each school the meanings for computer technology became fixed or obdurate in relationship to factors like the curriculum, pedagogical practices, the school's ethos, and the socio-economic status (SES) of the student body. At the section's beginning, I described obduracy as part of the paradox of malleability, which is what happens when a computer technology become contextualized—the technology's purposes and meanings go from being malleable to being fixed or obdurate. Thus, a technology's purposes and meanings become shaped, in part, by the setting where the technology is situated.

As I illustrated in the dissertation's four case study chapters, each school's setting was unique. For example, each school served a different population of students and they had different curricula and different slogans that represented their school's ethos. But the schools also shared similarities. The fifth grade students at all four schools created artifacts using word processing software and their educators all shared interpretations that computer technology was important for building confidence and developing skills. However, as I analyzed these similarities, there were striking differences that emerged from case to case. So, for example,

while the students at Komu Community and Aadu International both used Microsoft Word to create word processor artifacts, the artifacts served different purposes and helped the students develop different skills. At Komu Community, artifacts were part of developing life skills, like English proficiency, whereas at Aadu International, the artifacts were for "research skills." At Jinka Public, as an example, the student body's lower SES status and village location seemed to be social factors that influenced the fixed interpretation, among the school's educators and students, that the laptop should be used by the students to gain basic skills in English. Conversely, the social factors at Bara National were representative of a middle class status in urban Bangalore. As such, the Bara National's social factors seemed to influence the interpretation that the school's computer technology should be used for developing logic and programming skills. The obduracy of meaning for computer technology in Bangalore's elementary schools was shaped, in part, by the social factors that encompass a school's social context. However, there is more to each school's story than just social factors, there is also the interaction among social groups.

Stabilization and accessory social groups. The obduracy of a computer technology's meaning relates to a variety of social factors at each school, but it also is a reflection of the interactions among social groups. In this section, I address the complexity across cases by discussing the interactions among social groups that are part of what SCOT refers to as stabilization. Where malleability and obduracy have to do with a technology's interpretative flexibility in relationship to social factors, stabilization captures the negotiation process between social groups. Stabilization provides insight into the social groups' power dynamics. In particular, stabilization uncovers how power is negotiated among the social groups in a particular

context. Stabilization also helps shed light on why certain meanings for computer technology are agreed upon by social groups.

For example, Jinka Public School's social groups agreed that their laptop's primary purpose was for the students to build their English vocabulary. This purpose was shaped by and negotiated, in part, as a response to Jinka Public's social context, which is defined by the students' lower SES. Social mobility was the Jinka Public educators' most common rationale for why their students should use the school's laptop to learn English vocabulary. The educators often repeated that the laptop provided their students more opportunity for, as the educators put it, "a better life." The opportunity for a better life is part of the answer to the question of why computer technology is socially constructed the way it is at Jinka Public School.

Throughout the dissertation's case study chapters, I cultivated a theoretical basis for the role of accessory social groups in stabilizing the meanings for computer technology in schools. As a reminder, I define an accessory social group as a group of actors who have a high level of influence in shaping the meanings of a technology, but have a low level of inclusion in actually using the technology within the specific setting under study. I return to the Jinka Public example to help explain. The SSA Foundation was the non-governmental organization (NGO) that donated the laptop to Jinka Public School. As an accessory social group, the SSA Foundation was not involved in the day-to-day uses for the Jinka Public laptop, but it still maintained a high degree of influence related to the laptop's meaning as a tool for developing basic skills in English. The concept of accessory social group is an original and new contribution to SCOT theory; based upon my analyses of the data, using a grounded theory approach (Glaser & Strauss, 1967), I developed the notion of an accessory group to represent social groups that have a great deal of power and influence in a computer technology's social construction.

To structure this section's analysis, I discuss two themes that emerged across the cases in relationship to accessory social groups. First, accessory social groups, as represented by an organizational vision, had a great deal of influence in the lower SES schools, like Jinka Public and Komu Community. Second, accessory social groups, as represented by a set curriculum, had a higher degree of influence in the higher SES schools, like Bara National and Aadu International. I organize the rest of the section with paraphrased sub-headers for each theme. I start with the schools represented by an "organizational vision" and then move to a discussion of the stabilization in the "set curriculum" schools.

Organizational vision. The accessory social groups at Jinka Public and Komu Community dominated the stabilization of each school's computer technology through their organizational vision. Dominated is the terminology that SCOT theorist use to explain the power relationship among social groups as they interact and negotiate a computer technology's meaning. The SSA Foundation is the NGO donor organization that supplied Jinka Public with their laptop. As an accessory social group, the SSA Foundation also provided the vision for how the Jinka Public students should use the laptop. Their vision was that the students would maintain the laptop in order to spark their curiosity in technology and English. The SSA Foundation envisioned that the children would use the laptop to learn basic computer skills and English vocabulary. Finally, the SSA Foundation believed that the students' desire to learn subject matter, like English, increased when they were given stewardship for the laptop and allowed to plan out their learning experiences with the laptop.

At Komu Community, stabilization was dominated by the school's administrators, who were also an example of an accessory social group. The administrators' vision was that the Komu Community students would use the school's laptops to develop their English language

proficiency and their ability to operate computer applications. Both of these components or skills were included in Komu Community's official vision statement. Additionally, the administrators stated that both skills were essential parts of delivering "a high quality education" to all the Komu Community students. Since the administrators helped to train the school's novice teachers, their vision for the Komu Community laptops was dominant.

Although the SSA Foundation and the Komu Community administrators were not directly included in the daily classroom uses of computer technology, their organizational vision dominated because of their power. The locus of SSA Foundation's power was centered in their provision of the laptop and their communication of the way they believed the laptop should primarily be used as device for the students. The Komu Community administrators' power laid in their teacher training and continual communication for the pedagogical uses of the school's laptops. SCOT theory follows Anthony Giddens (1979) notions that power is a relational concept that has a "transformative capacity to harness the agency of others" (p. 93). The notion of power having a transformative capacity is an interesting one when applied to schools. Transformative capacity seems to be in contradiction with Bourdieu and Passeron's (1990) assertions about the reproductive capacity of power in school organizations, where schools often reproduce existing norms and societal structures. In the cases of Jinka Public and Komu Community, though, the accessory social groups maintained an organizational vision that the students' uses for computer technology would be more transformational than reproductive. Why was that?

Both Jinka Public and Komu Community serve low SES village students. The accessory social group at each school has an organizational vision that seeks to provide more opportunities for the students. For example, the SSA Foundation's CEO, Mr. Amit, talked about how the

laptop will "help prepare the Jinka Public students for a better future." The Komu Community administrators discussed how the laptops "empowered students with an education for life." Both accessory social groups also identified the importance of using computer technology to assist with learning English. So within the organizational vision of the SSA Foundation and Komu Community administrators, both believe that the uses for computer technology are part of transforming the lives of village students.

As I discussed in the Jinka Public and Komu Community case study chapters, I found it interesting that both accessory social groups referenced Dr. Sugata Mitra's (2001) "Hole in the Wall" project when discussing their beliefs about how students should use computer technology. Mr. Amit explained how Mitra's work informed the SSA Foundation's vision about letting the students' natural curiosity about computer technology shape how they use computer technology. Thus, a teacher's involvement should be at a minimum when it comes to computer technology. The Komu Community administrators also discussed how Mitra's scholarship inspired the school's vision about how the students' curiosity and interest in their laptops motivates them to want to learn more English to continue to operate their laptops. Both accessory social groups' organizational vision connected with Mitra's notions about minimally invasive education that allowed students the freedom to explore computer technology.

SCOT theory asserts that power in relationship to a technology's stabilization can be constraining and freeing. The organizational visions of the SSA Foundation and the Komu Community administrators does both. Their vision constrains the traditional Indian teacher as the sole transmitter of knowledge in favor of giving the students the autonomy to explore and use computer technology in ways they find interesting. Granted, both accessory social groups still guide the English language foci for the computer technology. Yet, their emphasis on English is

also in service to transforming the lives of the village students. Thus, in the cases of Jinka Public and Komu Community, the accessory social groups exercised their power to stabilize the meaning for each school's computer technology through an organizational vision meant to empower students with technology and English language skills.

Set curriculum. Accessory social groups were also part of the stabilization of meaning at the study's higher SES schools: Bara National and Aadu International. However, these accessory social groups' power was represented in each school's curricula rather than in an organizational vision. In their case study chapters, I discussed how Bara National's and Aadu International's curriculum shaped and stabilized the student uses of computer technology. At Bara National, I identified two accessory social groups connected with the school's computer science curriculum. The first accessory social group was the Bara Computer Science Team that wrote the computer science curriculum for all of the schools affiliated with Bara National. The second accessory socials group was the Bara National administration who officially approved and legitimized the school's computer science curriculum. At Aadu International, the accessory social group was the International Baccalaureate curriculum board, which provided the guidelines for what the Aadu International teachers should teach and how they should teach.

As I examine the role of each school's accessory social groups, I start with an important distinction related to each school's rhetoric about computer technology. Bara National, the middle SES school, the educators employed the term "computer science" to refer to its computer related classes. However, at Aadu International, the upper SES school, the teachers specifically referred to the school's computer technology as "ICT" and identified any computer related classes as "ICT time" or the "ICT class." This rhetoric was also represented by the differences in each school's computer related curricula. The Bara National computer science curriculum was

didactic and highly structured. Aadu International's ICT class curriculum was inquiry driven and highly integrated. Both curricula, though, focused on a set of learning goals that the students should develop with the aid of computer technology. However, these learning goals were completely different.

The Bara National computer science teaching team, which included ten teachers altogether (five computer science teachers from Bara National and five other computer science teachers from two nearby "sister" schools), focused the school's computer science curriculum on programming skills. In the Bara National case study chapter, I referred to this accessory social group as the Bara Computer Science Team. The Bara Computer Science Team designed the scope and sequence of computer science curriculum and wrote all the curriculum notebooks from first grade through twelfth grade for the three schools affiliated with Bara. The students used these notebooks like a textbook. The notebooks detailed the specific computer science skills (i.e., the learning goals) that the Bara Computer Science Team expected each grade level to master. The notebooks also explained the purposes for all the computer applications that the Bara National students would learn. For example, the purpose statement on the first page of the fifth grader's Microsoft Word notebook explained that, "Word processing is one of the most important activities carried out in a workplace. You use word processing for the preparation and presentation of documents."

The two Bara National fifth grade computer science teachers did not veer from this computer science curriculum at all. These computer science teachers also discussed how "Sir" (the Bara National CEO) reviewed and approved the computer science curriculum. There was an expectation by "Sir" and the rest of the school's administration that the teachers would cover the entire curriculum over the academic year. Thus, both the Bara Computer Science Team and the

school's administration were accessory social groups as they wielded a high degree of influence regarding the meanings for Bara National's computer technology, but were not necessarily included in the daily classroom uses for the computer technology.

The International Baccalaureate (IB) Organization stabilized the meaning for the Aadu International computer technology through the IB curriculum. Like I explained in Chapter 6, the IB curriculum is an extension of the IB Organization. However, unlike Bara National, which had a very hierarchical structure of stabilization, the IB curriculum offered an egalitarian approach that ceded power to the Aadu International students to used ICT as an inquiry tool. The ICT learning experiences were also contextually bound and integrated within Units of Inquiry. The IB curriculum model emphasized how students should use ICT for their research and presentation of ideas they developed throughout a unit. Rather than a focus on computer related skills, the IB curriculum focused on how ICT helped students develop the competencies of an "IB Learner," which included the competencies like knowing how to be a: balanced thinker, ethical inquirer, leader, and a risk taker.

Thus, the IB curriculum model was an accessory social group that stabilized the meanings for ICT by fostering a consensus among the Aadu International School teachers and students about ICT's purposes. The students used the school's ICT to support their research and inquiries of the IB curriculum. The Aadu International teachers gave the fifth grade students autonomy in their research and inquiry. However, the teachers set the parameters for this autonomy by giving students a range of choices for their unit projects. These choices steered the ways that Aadu International students chose to use the school's ICT (i.e., choices include creating PowerPoint presentations for unit projects and writing essays). This kind of learning model was established through IB curriculum.

While there were differences among the accessory social groups at Bara National and Aadu International, each accessory social group's power was grounded in the curriculum. At Bara National, the computer science curriculum was written by the Bara Computer Science Team, all of whom had at least a Bachelor's degree in computer science. The team designed the curriculum around skills that would prepare their graduates for jobs as software engineers and computer programmers. Thus, the Bara Computer Science Team exercised their power by designing a set curriculum that reproduced the knowledge and computer skills necessary for computer programming (Bourdieu & Passeron, 1990). Furthermore, the Bara computer science curriculum was appraised by the school's administration, including the CEO of all Bara schools. With "Sir's" (which is how the computer science teachers referred to the CEO) approval, the computer science curriculum gained legitimacy among the Bara National students, teachers, and parents. The Aadu International students and teachers ICT use was also guided by a set curriculum given by the IB Organization. However, the IB curriculum focused more on developing learning competencies (e.g., being ethical inquirers) rather than on programming skills. Thus, the IB curriculum at Aadu International exercised their power to stabilize an integrated meaning for the school's ICT with an emphasis on learning competencies. In contrast, the accessory social groups at Bara National were connected with the school's computer science curriculum and exercised their power to stabilize the meanings for the school's computer technology through a skills based curriculum.

Discussion. Throughout the section I examined how accessory social groups exercised their power either through an organizational vision or through a curriculum to stabilize each school's meanings for computer technology. I also analyzed why certain meanings for computer technology were stabilized. As part of this analysis, I identified the relationship between the

school's predominant SES and the stabilization process. However, there is more to stabilization than just a story of social-economic reductionism; the stabilization of computer technology shows interrelationship of obduracy, power, and SES. Stabilization has more to do with vision statements and curriculum than solely with socio-economic structures.

Jinka Public and Komu Community, as examples, were both lower SES schools while their accessory social groups were representative of India's middle SES. In both schools, these accessory social groups' organizational vision dominated the meanings for the computer technology. The SSA Foundation and Komu Community administrators shared a similar vision to transform and empower the lower SES students with technology and English language. However, if this organizational vision was just reduced to SES, was it the students' lower SES status that shaped the vision or was the accessory social groups' own middle class background more influential in shaping their organizational vision? Such a conundrum should refute notions or tendencies to reduce technology's social construction to just a response to SES.

While SES was an intentional part of the study's design and selection criteria, the students' nor the accessory social groups' SES level does *not* tell the whole story. If SES did, then one would not expect the highest SES class students (i.e., Aadu International) and the lowest SES class students (i.e., Jinka Public) to share some findings in common. Two findings existed. The first finding was that the fifth graders, at both schools, were given the most amount of autonomy related to how they could use their school's computer technology. While their purposes for use were different, the Aadu International students and the Jinka Public students were allowed the most choice. Interestingly, the rationale for this choice was similar as well. At Aadu International, the IB curriculum model, which is based in inquiry, provided the rationale for student autonomy with computer technology. At Jinka Public, the SSA Foundation's

organization vision, which was partly based on Deweyian notions that children should plan their own programs for using computer technology, provided the rationale the Jinka Public students' autonomy with the school's sole laptop. The second finding had to do with resources and the computer hardware. At both schools, Aadu International and Jinka Public, there were not enough laptops or computer technology for every student. So students had to negotiate a schedule to share the school's computer technology.

In sum, SES is a social factor that is a part of the stabilization of computer technology in schools, but SES does not govern the entirety of a computer technology's social construction. Rather, computer technology's social construction in schools is a reflection of many social factors that includes the interactions among accessory social groups and relevant social groups. Indeed, the influence of accessory social groups, through their through organizational visions and set curriculums, stabilized and often dominated the meaning making for each school's computer technology.

The wider sociotechnical context. Up to this point in the chapter's "hourglass analysis" of cross-case themes, I have described computer technology's malleability related to the wider context of Bangalore's elementary schools. I discussed how malleability is one way of explaining the multitude of meanings (i.e., the sum of all social groups' interpretative flexibility) for computer technology. Within the case studies, I examined obduracy, which is when a certain unitary meaning for computer technology becomes fixed in relationship to social factors. In the previous section, I identified each school's accessory social groups and discussed their role in stabilizing the meanings for computer technology either through their organizational vision or their set curriculum. Now, in this final section, I compare each school's technological frame in relationship to the wider sociotechnical context. Specifically, I discuss the final statement in the

chapter's thesis, which is: Stabilization occurs within a school's technological frame; and each school's technological frame is a reflection of Bangalore's wider sociotechnical context.

Bijker (2010) asserts that the technological frame allows one to explain the stabilization process in deeper contextual ways through an inquiry about why a computer technology's social construction follows a certain way. SCOT explains that the technological frame is the combination of the social factors and the interactions among social groups in specific settings. The technological frame shapes the social groups' meanings for computer technology and is "built up when interaction 'around' the computer technology begins" (p. 69). On a sociological level, the concept of technological frame is rooted, in part, to symbolic interactionism (Bijker, 1995; 2001; 2010). Indeed, SCOT reflects Blumer's (1969) assertion that: (1) People act toward things, like laptops or computers, based on the meanings they assign to those things; (2) People derive the meanings for things, like a laptops, based on their interactions with others; and, (3) People use an interpretative process to negotiate the meanings for things.

If I were to interpret the findings from a symbolic interactionism perspective, each school's technological frame would be about the social groups' interactions and how those interactions narrowed in on a symbolic meaning for school's computer technology. For example, from a symbolic interactionist perspective, the Jinka Public School's sole laptop would be the symbol for a better life. At Komu Community, the school's one to one laptop program could be a symbol of empowerment or equal opportunity. At Bara National, the school's computer lab might stand as a symbol for logic. At Aadu International, the school's computer technology might be a symbol of ownership. This, again, is from a symbolic interactionist perspective as a sociological theory.

Yet, SCOT is more than just a sociological theory. Rather, SCOT attempts to wed sociological theory with technological theory (e.g., Hughes, 1983). Bijker (1995) identifies this union as the "sociotechnical" part of SCOT theory. The sociotechnical represents a wider societal context and includes the political and economic dimensions of the social shaping of technology. Bijker (1995) uses the example of a light bulb to explain the sociotechnical, "The 'stuff' of a technological invention like a florescent light bulb was economics and politics as much as electricity and fluorescence. This 'stuff' is the sociotechnical of technology" (p. 273). In many SCOT studies, the sociotechnical gets overlooked or dismissed for technological minutiae; however, examining the wider sociotechnical context provides insights about the relationship of technology's social construction to the political and economic dimensions of a society (Bijker, 2010). In the rest of this section, I investigate the wider sociotechnical context of Bangalore, India, through an examination of each school's technological frame.

Now where to begin with such an examination? SCOT theorists suggest starting with two promising units of analysis for the investigation and comparison of the sociotechnical within technological frames: artifacts and future uses. Artifacts are meaning bundles; artifacts illustrate the "hardened networks of practice around a technology" (Bijker, 2010, p. 282). An analysis of artifacts reveals the sociotechnical. Put more simply, "artifacts have politics" (Winner, 1980, p. 122). Here politics means power and the negotiation of power that takes place among social groups of people. So another way to interpret the meaning of artifacts is through an explanation of artifacts as part of the way to secure power in a society. Using my earlier analysis of artifacts from this chapter as examples, I extrapolate that the skill set represented within each school's word processing artifact shows an understanding of a way to secure power, even if it is just a small degree. A pathway to power: at Jinka Public is through "basic skills" like English

vocabulary and typing; at Komu Community it is through "life skills" like English proficiency and presentation; at Bara National the power pathway is via "programming skills" for engineering software; and at Aadu International it is through "research skills" for idea ownership. Artifacts become declarations of power represented in the exercise of these skills. The artifacts shed light on the importance of English language, software engineering, and idea ownership to Bangalore's wider sociotechnical context.

Future uses for computer technology is another unit of sociotechnical analysis. Indeed, SCOT argues that an analysis of the sociotechnical includes an investigation into how technology guides future uses (Bijker, 2010). Looking to the future means examining what social groups believed that computer technology equips them to do. In the rest of this section, I compare and discuss the theme that all the social groups in this study interpreted computer technology as a primary means for future possibilities.

Educators' notions of future possibilities. Across the schools, the educators shared a similar interpretation that computer technology was a key part of their students' future opportunities. The Jinka Public teachers explained how the school's sole laptop would make their students lives "better" in the immediate future and distant future. To their immediate future, the teachers thought that Jinka Public students would be better prepared for going into the secondary schools where there were computer labs. For the distant future, the teachers identified the affordances that the laptop represented in learning English and employment. Mr. Pahal, the school's language teacher, put it this way, "The laptop gives the children more confidence in their English to get a job in Bangalore." The Komu Community teachers expressed a similar sentiment. Ms. Eshani, the lead ICT teacher, stated it this way, "Computer technology helps their future. They are still learning, but the computer is a help because they will need to know

how to use the computer when they go to Bangalore for a good job." The sociotechnical emerged in the two teachers responses. Both teachers focused on the future employment opportunities, especially in Bangalore, that computer technology represents. Mr. Pahar also associated a job in Bangalore with confidence in speaking the English language. Like the skills that the Jinka Public and Komu Community

The Bara National teachers connected future opportunities with understanding the logic of tools rather than focusing solely on a career. For example, Ms. Sanchana explained that, "The future is about enhanced appliances. We now have computers, but in the future it could be different appliances. When the students understand the logic of enhanced appliances, they can use any appliance whether now or in the future." The Aadu International teachers also shared a similar interpretation. Ms. Darsha, the lead fifth grade teacher at Aadu International, explained the connection to the future in this way, "The children are prepared to create and present with the computer. This is also preparation for their future career. I think that the computer will be indispensible to them in the future." Notions about the sociotechnical also emerged from the Bara National and Aadu International educators' responses. However, these notions had more to do with the importance of understanding computer technology as a tool. For example, Ms. Sanchana's response highlighted the importance of understanding the logic of technology whereas Ms. Darsha emphasized the importance of using computer technology to create and present. Understanding the logic of computer technology and knowing how to create with computer technology are two knowledge areas that often get rewarded in Bangalore.

Although teachers at all four schools indicated that computer technology skills was critical for future career opportunities, those career opportunities differed by school. In these examples, the sociotechnical is reflected in the teachers' perceptions of the relationship between

computer technology and future opportunity. On the question's surface, the educators agreed that computer technology is part of preparing students for a future career. As soon as the teachers start to explain, the different interpretations and technological frames emerge. The Jinka Public teachers identify the relationship between computer technology and future possibilities with: building confidence, English language, Bangalore, and a job. The Komu Community teacher also associates the relationship between computer technology and a future career with Bangalore and getting a good job. The Bara National teacher interprets the relationship as something akin to logic readiness. The Aadu International teacher understands that creating and presenting are part of the relationship between computer technology and a future career.

Students' notions of future possibilities. The students across schools shared their interpretations about the future possibilities because of computer technology. The students' notions of future possibilities were different across schools. These differences shed light on the intricacies that part of the wider sociotechnical context. All the students shared a positive reply to my student focus groups question about whether or not computer technology will help them in the future. Students started their response with an enthusiastic "yes" or "of course!" However, the differences in their perceptions of the future emerged as the students explained why they believed that computer technology prepares them for the future.

The Jinka Public students responded with references to increased opportunities and social mobility. For example one Jinka Public fifth grade student explained, "The laptop is how you [they were speaking to me] were able to come to our country, so in the same way, we learn the laptop to be able to go to your country [the United States]." In this explanation the Jinka Public student communicated the future possibilities that computer technology offered. The students

also expressed a motivation to learn how to use the laptop because of a future opportunity it could afford them. While the these opportunities included the aspiration of social mobility, including travel to the United States, the Jinka Public students were vague about the details of what that kind of social mobility required.

In their explanations for how computer technology prepares them for the future, the Komu Community students also resonated with the theme of social mobility, but the Komu Community students were more specific about the details. For example, a fifth grade girl, responded to the question of the relationship between the school's computer technology and her future by sharing, "Sir, someday I will speak better English. Then I will be a 'big boss' and use the computer in a 'big boss' office." I found out from the Komu Community teachers that 'big boss' meant something like a mid-level manager in a corporate office. The Komu Community students adopted the term 'big boss' from a popular Indian television series. The girl response included an association with better English and working as a big boss. She also communicated that she would continue to use a computer in the big boss office. This Komu Community fifth grader's explanation was shared by many of her class mates; a job like a 'big boss' required better English and knowing how to use a computer.

In general, the Bara National student focus group responses to my interview questions were straightforward and pithy. Their responses were more about future security than social mobility. For example, a Bara National fifth grade boy explained that computer technology will benefit him in the future because, "When a boss gives me a job to do on the computer, I will know how to do it." A Bara National fifth grade girl agreed with the boy and added that, "When I join a company later in life, I will know how to do my work projects fast and I will be able to enjoy work projects because I will know all about how the computer works." Another fifth

grade boy had this to share, “In the future, if you don’t know Word or PowerPoint then you will be stuck. If a boss gives you a project or a presentation to prepare, knowing Word and PowerPoint will help you be able to complete it.”

During the student focus interview, I was struck by how often the Bara National students made reference to “work projects” and “bosses assigning work.” In their responses, the Bara National students recognized their role in the larger sociotechnical context would be as highly skilled workers with knowledge of computer systems. Conversely, the students did not identify themselves as a leader, a future boss, or a CEO. Rather, many of the students were already consigned to a future of being professional, middle class workers, like computer programmers and software designers. They would join a company, work fast and efficiently, and be expected to complete work projects that would require knowing “all the parts of a computer.”

The Aadu International student focus group responses were almost in direct contrast with what the Bara National students shared. When I asked the Aadu International students to explain why they believed they were being prepared for the future because of the school’s computer technology, a fifth grade boy immediately responded with, “When I grow up I will have my own company, computer technology will help people learn about my company. Also, I will need to know how to continue to use the computer to communicate to my workers.” A girl in the student focus group had this to share, “I think it is both the computer technology and our teachers that are helping our future. The teachers want us to know how to use computer technology for ourselves so that we can find good information.”

The Aadu International student focus group responses were indicative the themes regarding idea ownership, leadership, and entrepreneurial skills. This was most evident in the response of the fifth grade boy who desired to own his company. He identified that advertising

and communication were affordances that computer technology would offer his future business. The girl spoke about "using technology for ourselves" with the goal of "finding good information." In contrast to the Bara National focus group, the Aadu International students communicated their ownership over what computer technology allows them to do. Rather than being workers, the Aadu International students perceived themselves as being the owners of information. The differences, by school, in students' notions of their future opportunities reflect each school's unique technological frame. Each unique technological frame incorporates political meanings that allows one group of students to socially construct computer technology to become socially mobile (i.e., Jinka Public) while another group of students cast computer technology as part of their future as CEOs (i.e., Aadu International).

Future career options reported by students. The differences in the students' notions of future opportunities also became evident from their responses to the following short answer question on the student questionnaire: "What kind of job would you like to have in the future?" In analyzing the data from this question, I first noticed the differences in response variety. For example, the Jinka Public students wrote in one of three different responses: teacher, software engineer, or police. Granted there were only 11 fifth grade students at Jinka Public, but I thought the students would share more variety of responses. Of the 50 fifth graders at Komu Community, they wrote in 12 different job possibilities. In terms of preference variety, girl students were the only ones who wrote in "teacher" at Jinka Public and Komu Community. Bara National had 104 students complete the questionnaire and the students wrote in 25 different job preferences. Seven Bara National students wrote in "Undecided" as their response to the question with one student including an exclamatory note stating: "I am too young to even decide!" Aadu International had the most variety of responses as the 65 students who completed the survey

listed 28 jobs they were interested in the future. I tabulated and organized the top three most cited job preferences by school. Table 8 shows the top three responses for each school as well as the selection percentage of each job.

Table 8

Top Three Most Cited Job Preferences by School

	Most Cited Job Preferences		
School	First job (% cited)	Second job (% cited)	Third job (% cited)
Jinka Public	* Teacher (55%)	Software engineer (27%)	Police (18%)
Komu Community	Software engineer (36%)	* Teacher (30%)	Military (12%)
Bara National	Software engineer (31%)	Doctor (18%)	Scientist (11%)
Aadu International	CEO (17%)	Veterinarian (11%)	Author (8%)

Note. The asterisk sign (*) before the job title signifies that the response was cited exclusively by one gender. At Jinka Public and Komu Community, only female students wrote in "teacher."

Like Table 8 shows, software engineer, teacher, and police or military were the three most cited job preferences among the Jinka Public and Komu Community students. It was not surprising to see the high percentage response for "teacher" (or that it was only female students who wrote in this response) since it is well established in the literature that Indian parents of underprivileged female children often desire that their daughters go into teaching, because teaching is considered a secure government job that has some degree of flexibility for family

planning (Advani, 2009; Pal, 2008; UNESCO, 2010). To some degree, a similar perception exists with a military or police office job for sons in underprivileged families. The male children are encouraged to join the military for the security that job offers.

However, about one third of students at both Jinka Public and Komu Community identified software engineer as their job preference. Close to the same percentage of Bara National students (31%) also reported software engineer as the top job preference. The other two most cited job preferences of the Bara National students (doctor and scientist) are jobs that align within the spectrum of India's middle SES. Finally, the Aadu International students' responses not only had the most variety, they shared no real commonalities with the other schools. For example, only one student at Bara National wrote in "CEO" as a job preference on the questionnaire compared with the eleven students at Aadu International who wrote CEO as their preference. Five of the Aadu International wrote in Author as their job preference, which is a job that also requires a great deal of original thinking and ownership of ideas. Perhaps the most interesting difference among the schools with regard to job preferences was simply the difference in amount and type of jobs that the Aadu International students wrote in. Not only did the Aadu International students list 27 different job preferences, they were the only group to include job titles such as banker, astronomer, racehorse breeder, and land developer.

Discussion: The middle class narrative. I closed each case study chapter with a question about whether the technological frame could be reduced to a story about each school's meanings for computer technology in relationship to its predominant SES. The short answer here is no. The whole point of social construction theory is that a technology is constructed in different ways and for many different reasons. Indeed, the social construction of technology is more than just economic determinism or socio-political reductionism. SCOT employs technological frames

as a way to broaden each story to discuss a wider sociotechnical context that includes (but not limited to) an economic dimension, a political dimension, a social dimension. Hence, the technological frame reflects the complex and diverse social-cultural factors in a particular setting. Kirkpatrick (2008) describes a technological frame in this way, "The technological frame is a discursive system of reference that insures that while social groups may have different interpretations for a technology they are nonetheless working together in the construction of a common object" (p. 27).

I analyze this section's themes about technological frames by starting with the acknowledgement that perceptions about future opportunities are more than just reflections of social class. Yet, social class, especially in relationship to India's middle class narrative, does seem to be influential. By social class, I follow Sen's (2005) notion that, in India, social class is a federation of cultural, economical, political, and social arrangements. These social class arrangements are institutional in how they reinforce existing power structures. But these arrangements are also influential as they are integrated into the life of India and can be "transformational" (Sen, 2005, p. 207). Such is the influence of India's middle class narrative, which "despite the fuzziness of its boundaries . . . spearheaded the modernization of Indian society and gave shape to its modern institutions" (Beteille, 2007, p. 290). The middle class narrative is India's great magnet; the lower class is drawn to the middle class narrative's promise of security and prosperity while the upper class is drawn to the middle class narrative's broad base of skills and English speakers (Deb, 2011; Guha, 2008; Kumar, 1991). While some question whether the India's middle class narrative is just myth (Birdsall, 2010), the middle class narrative, as represented by a skilled technology workforce who speak English, is one way of interpreting each school's technological frame.

I argue three plausible themes related to the study's technological frames and the Indian middle class. One theme is about using computer technology in order to gain the necessary skills for entry into India's middle class. A second theme is about reproducing the knowledge and programming skills necessary for a secure middle class job. The third theme is about knowledge ownership and the reliance on the middle class. To assist with unpacking this discussion, I refer to Figure 4, which is a graphic representation of the themes related to the technological frames of the schools.

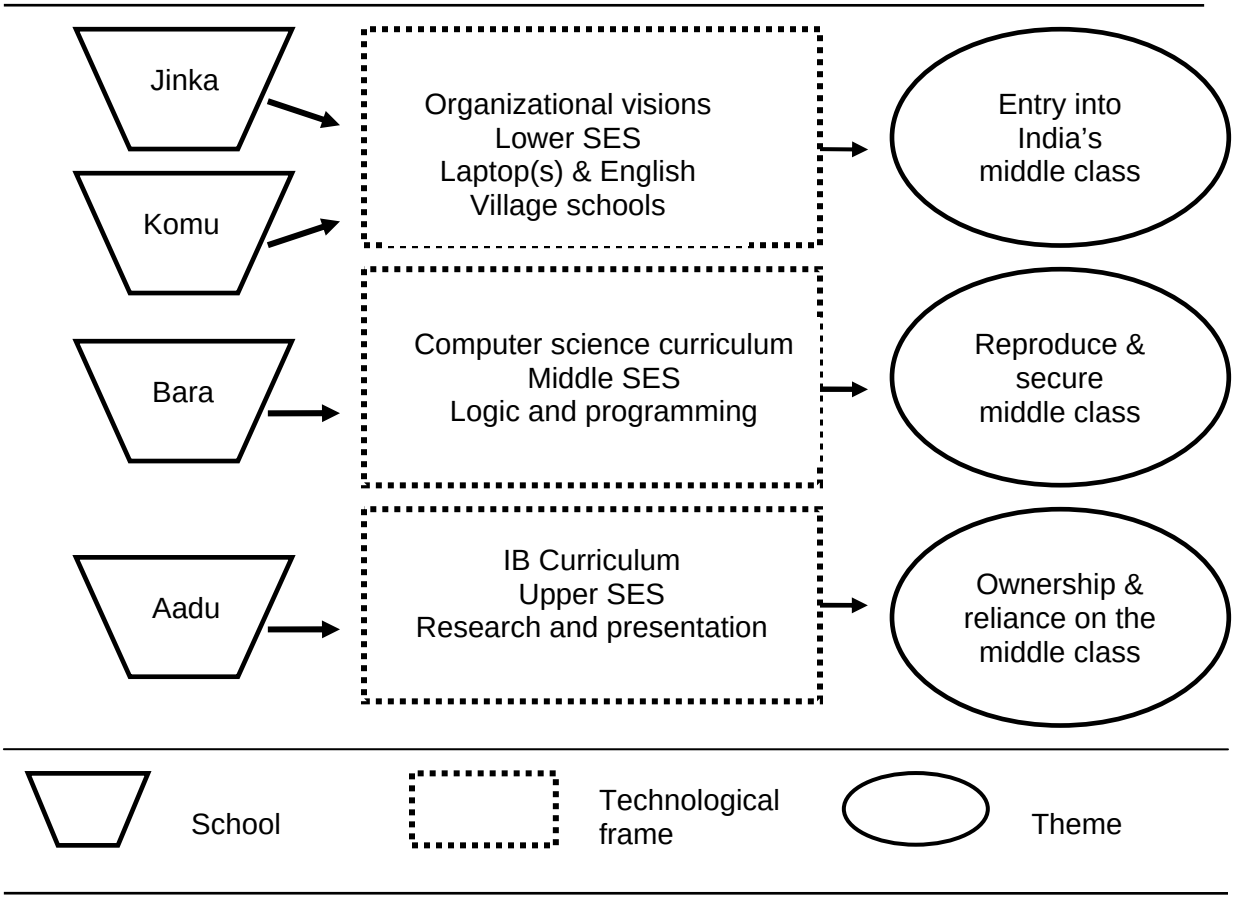

Figure 4. Themes that emerged from each school's technological frame.

As Figure 4 shows Jinka Public and Komu Community were the study's lower SES schools. Both schools were village schools and both shared a similar meaning for their school's

laptop(s). The social groups at both schools interpreted computer technology as a tool for English language learning. Additionally, the social groups framed their discussion of the computer technology's meaning around rhetoric about empowering students with English language and technology skills to provide more opportunities for a better life. Such rhetoric captured the possibilities of gaining entry into India's middle class. Additionally, the organizational vision of each school's accessory social group further stabilized that theme. Both accessory social groups were arbitrators of power in their commitment to the vision of providing a "better life" through the use of computer technology to gain exposure and proficiency in English.

Although Jinka Public and Komu Community share the same theme regarding entry into India's middle class, I want to make a conceptual distinction between opportunity and empowerment. At Jinka Public, the social groups, including the SSA Foundation, spoke about the laptop as providing an opportunity for a better life. At Komu Community, though, the message regarding the laptops was much stronger among the social groups, especially the school's administrators. At Komu Community, the laptops were interpreted as empowering. I recognize a subtle, yet important, difference in the two notions. In the case of Jinka Public, opportunity is synonymous with chance. That means the Jinka Public had a chance at a better life because of the school's laptop, but chance does not guarantee that it is going to happen nor does it mean that the students will be guided along the way. At Komu Community, though, the conception is that the laptops, along with the guidance of the teachers, empower the students with the skills necessary to gain entry into India's middle class. The future opportunities and job preferences that I analyzed earlier reflect the possibilities that the Indian middle class offers.

Figure 4 also shows how Bara National School's technological frame includes the stability of computer science curriculum and the predominance of a middle SES. Since the Bara National students already belong to India's middle class, the computer science teachers enacted a computer science curriculum that would reproduce the knowledge and skills necessary for securing a stable, middle class job in computer programming. The Bara Computer Science Team, as an accessory social group, were power reproducers as they crafted a curriculum to reproduce the logic and coding skills required for a secure career in the computer technology industry. The future opportunities and job preferences that I analyzed earlier reflect the security that the Indian middle class offers.

Figure 4 demonstrates how the third theme regarding ownership and reliance on the middle class fits into the Aadu International's technological frame. The Aadu International social groups centered their meanings and purpose for the computer technology on the ownership of ideas. Idea ownership and original thinking are valuable characteristics of entrepreneurs and leaders. The IB curriculum model, as a social accessory group, is also a power reproducer as the curriculum focuses on developing IB Learners who understand the proprietary value of their ideas. In such proprietorship of ideas, though, there is a nod to the reliance on the middle class as the workers to help sustain those ideas. Such an acknowledgement of the middle class is captured in the quote by the Aadu International fifth grade boy, "Computer technology will help people learn about my company. Also, I will need to know how to continue to use the computer to communicate to my workers." The reliance on the middle class is a tentative and nebulous finding related to this current study that needs further investigation.

In sum, according to SCOT, the technological frame provides a frame of reference among all the social groups in a particular setting that structures the social groups' interactions. One

way to interpret each school's technological frame is to overlay a wider sociotechnical context about India's middle class narrative. This is especially poignant in the context of Bangalore, where the middle class' social capital includes English language skills and computer technology skills. In relationship to the larger middle class narrative, the dissertation's case studies provide four stories that shed light on the uses, meanings, interactions, politics, and possibilities related to computer technology in Bangalore's elementary schools. And, yet, these are only four stories.

CHAPTER 9

CONCLUSION

BACK TO THE BANGALORE CHALLENGE

This dissertation investigated stories of the meanings and purposes for computer technology in four of Bangalore's elementary schools. These stories are situated in the two paradoxes I identified in India: the first paradox relates to the country's relationship with technology; the second paradox relates to the use of computer technology in elementary schools. I briefly revisit these paradoxes here and explain how my study reinforces and complicates the existence of these paradoxes.

Indians place great importance on computer technology skills, yet only a small proportion of the Indian workforce work in the computer technology industry. On the one hand, the Bangalore Challenge exists because India has developed an international reputation in computer technology. On the other hand, this reputation has been developed by a relatively small proportion of the country's population: most Indians never have the opportunity to acquire computer technology skills. The second paradox, related to the first, is the tension between the country's fascination with computer technology and the absence of computer technology from most elementary schools. The schools in my study were not representative of the majority of India's elementary schools since each of them used some form of computer technology. I am mindful that these are stories of privilege. The elementary schools in this study were privileged to have computer technology in their schools. Thus, a school like Jinka Public, even with only one laptop for the whole school, is privileged because its students are being equipped with some kind of computer technology skills.

Even though the schools were privileged it did not mean that all the schools shared the same meaning for computer technology. Indeed, the meanings were quite varied and, depending on a school's social factors, were quite context specific. Computer technology continues to play an important role in the Indian economy and social life. While only a small proportion of India's population is employed in its ICT industry, computer technology has a great amount of symbolic capital. In Bangalore's elementary schools, for example, some students understood that computer technology would provide opportunities for a better life by learning English whereas other students understood computer technology as tool for developing proprietary knowledge. Thus, the privilege of having computer technology represented different narratives about securing the possibilities of higher status and a better life in India. My study further complicated the paradoxes by showing that even if students do have access to technology, social class plays a critical role in the types of technology skills they are taught.

Computer technology will continue to be important to India's future and there will also continue to be multiple narratives about why computer technology is important for India's children. Indeed, stories of these four schools are not the only stories of my experience collecting data in India. During my ten months in Bangalore, I had the opportunity to visit other schools and educational settings that were also constructing meanings for computer technology. For example, I think of the Ramji Center, an afterschool computer center in one of Bangalore's largest slums, where slum children go to create colorful posters with a Free and Open Source (FOSS) design application called TuxPaint. The children develop technological literacy and confidence as they craft and produce social justice oriented posters that raise awareness about Bangalore's slum conditions. The Ramji Center participants constructed different kinds of meaning for computer technology. For the center's participants, computer technology became a

way to develop consciousness and advance self-determination. One of the Ramji Center teachers, a 15 year old girl who also lived in the same slum, explained it like this, "The world will tell us that the slums are where we belong, but knowing the laptop is our way out, and it is the children's way out, too."

At another elementary school I visited, the Kripa School, the students were learning how to use Microsoft PowerPoint and Microsoft Excel programs to create, promote, and manage fictitious businesses. The Kripa School participants interpreted that the purpose of computer technology was for developing applicable, business skills; skills that would serve them well in managing a future small business. The Ramji Center and Kripa School offer additional narratives of computer technology's social construction in Bangalore. These are stories for a different time. But, like the case studies in this dissertation, these stories show that in order to understand what computer technology means it is best to start with how and where the technology is being used. Throughout this dissertation, I have explored how computer technology is used in elementary schools in Bangalore, India. I conclude the dissertation by considering how the stories map on to the wider Indian context. To do this, I examine how the dissertation's findings and cross-case analyses relates to the literature that framed my study. I then move to a discussion of technology and the future as represented by the Bangalore Challenge. Finally, I finish the chapter with my recommendations for further study as well as share my arguments related to the dissertation's educational significance.

Situating the Findings in the Literature

The central goal of this study was to investigate the contextual uses for computer technology in Bangalore's elementary schools. I used the Social Construction of Technology theory to guide that examination. The study's main purpose was to thickly describe and compare

computer technology use in Bangalore's fifth grade classrooms. The dissertation confirmed many findings in the literature on technology use. These findings include the scarcity of technological resources in Indian village schools (i.e., Jinka Public School) as well as the way the computer technology is used in Indian schools to primarily reinforce a computer science curriculum (i.e., Bara National School). Yet, the dissertation's case study chapters provided a deeper context for understanding each of these findings.

Furthermore, the dissertation offered more complex findings about the meanings that India's elementary schools teachers and students assign to computer technology. In the wider literature, there are two sources, in particular, that provide additional insights about the findings in regards to elementary schooling and India: (1) Jean Anyon's (1981) work on social class and school knowledge and (2) Krishna Kumar's (1989) scholarship on the social character of learning in India.

Anyon's (1981) study on the construction of school knowledge in elementary schools in New Jersey provides a valuable interpretive lens for the dissertation's findings related to social class. Although my study is separated by time (more than 30 years), distance (nearly 8,000 miles), and context (i.e., social, economic, political, cultural, linguistic, and so forth), I assert that Anyon's work still offers a useful framework for investigating the relationship between SES and elementary schooling. Two schools in this study, Aadu International and Bara National, most closely related to Anyon's findings. Aadu International, the dissertation's upper SES school, was a mix of Anyon's "affluent professional school" and "executive elite school." Anyon describes the "affluent professional" school as a representative of the United States' upper middle class. In her study, the "affluent professional" school emphasized the importance of creativity along with a deep understanding of concepts. This is similar to Aadu International's

sign about curiosity and creativity being cousins. Anyon describes the "executive elite" school as representative of the United States' wealthiest families. According to Anyon, in an "executive elite" school the curriculum stresses the development of analytical and intellectual capacities.

This echoes much of the pedagogy at Aadu International, where students were taught to "think for themselves" and develop the thinking and research skills (i.e., intellectual skills) that would aid them in becoming tomorrow's leaders. Anyon (1981) contends that knowledge ownership also includes being willing to question knowledge. At Aadu International, students were encouraged to ask questions. Additionally, questioning was part of the school's standard operating procedure for researching with the computer. Yet, not only did the Aadu International students question the practicality of certain activities on the computer (this was especially common in their ICT class), but they were also asked to question the reliability and credibility of the sources they cited as part of their research.

Findings from Bara National, the dissertation's middle SES school, were similar to the middle class school in Anyon's study. According to Anyon, middle class schools and their teachers view knowledge as having a market value, where knowledge is acquired and produced for the purpose of being consumed. Anyon (1981) calls this the "commodification of knowledge" (p. 33). As a commodity, knowledge has an exchange value and can be traded in for a secure job or career. Knowledge commodification reverberates through Bara National lead computer science teacher's statement that 80% of the school's graduates go into a computer technology field in Bangalore. The knowledge of computers or, more specifically, of computer programming has a great market value in India as well as in much of the developed world. Thus, the Bara National computer science teachers prepare their students with that kind of knowledge through a highly structured and sequenced curriculum based on logic, coding, and programming.

Anyon suggests that students in middle class schools are usually willing to work hard because of the high reward (i.e., future job security) that the reproduction of knowledge represents. The posters on Bara National's walls capture Anyon's point here; Bara National's students are reminded that "quality work gets you noticed" (as the poster in the computer lab states). The students work hard at mundane computer related tasks and do not question the knowledge. Such behavior "legitimates production for consumption" (Anyon, 1981, p. 34). It reinforces the understanding that Bara National's computer science curriculum helps students get into the right Indian colleges and eventually land strong middle-class in a computer related field.

The dissertation offered findings that extend beyond Anyon's study. The findings from Jinka Public and Komu Community were a departure from Anyon's findings related to lower SES schools (or "working class" schools). According to Anyon, knowledge and curriculum in lower SES schools are often quite disconnected from the lower SES students' history and possible futures. Yet, at Jinka Public and Komu Community, I found the exact opposite. In examining the findings at Jinka Public and Komu Community, I found Krishna Kumar's (1991) scholarship on the social character of learning more relevant. Kumar asserts that education in village schools is a mix between the local culture and national politics. The findings at Jinka Public and Komu Community support the notion that at the Indian national level, English language and technology skills are quite valuable. Kumar emphasizes that parents and policymakers hope that the school, especially in villages, is a place of possibility for a better future for Indian children. In both cases, Jinka Public and Komu Community, the computer technology was interpreted as a tool for transforming their students' future.

At both schools, the emphases on computer technology were deeply connected to the students' aspirations and to their future. For example, at Jinka Public, the students were the

owners and caretakers of the school's laptop. The Jinka Public students were largely responsible for shaping the laptop's curriculum and activities that were centered on their aspiration to learn English for "a better life." Thus, the Jinka Public laptop became a tool for future opportunity. In the same way, the laptops at Komu Community were part of the school's "equal opportunity" mission. The Komu Community educators viewed the laptops as a way to empower the students. Rather than being a tool of reproduction or even oppression, which is how Anyon characterizes lower SES schools' curriculum, the Komu Community laptops were tools for transformation. The students were engaged with computer related activities, like creating English language advertisements, which represented practical types of computer-based skills.

The Wider Story

The wider implication of this dissertation is that the study helps explain (and complicate) the wider story of the confluence of computer technology and elementary schooling in Bangalore, India. In the dissertation's first chapter, I discussed how this confluence was a reflection of India's two commitments. Computer technology is a representation of India's commitment to development through its ICT industry. Elementary schooling is a representation of India's commitment to sustainability by providing universal elementary education to all its children. Investigating this interrelationship of commitments has provided new and deeper narratives for how students and teachers construct meaning for computer technology.

One narrative is from an economic point of view. Krishna Kumar (1989) posits that, "Schools equip individuals with knowledge and skills that are appropriate to the tasks generated by the economy and supported by politics and the local culture" (p. 69). One picture of the wider story is related to how the four case study schools equipped their students with computer technology skills in response to the "tasks generated" by Bangalore's middle class narrative;

tasks which become forms of symbolic capital. For example, the village students at Jinka Public and Komu Community were being prepared with English and technology skills for entry into middle class kinds of tasks. The Bara National students were being trained with the logic and coding skills necessary for secure, middle class jobs as computer programmers. The Aadu International students were being prepared with research and leadership skills that foster the ownership of ideas and entrepreneurship; and, such entrepreneurship often relies on the middle class for sustenance. These combined findings from the four case study schools present a socioeconomic narrative about technology's social construction in Bangalore's elementary schools.

I could also explain the social construction of technology in Bangalore's elementary schools from more of a pragmatic point of view. From this perspective, the dissertation's wider story would be about how the teachers and students use their school's technology based on what is most practical or what makes the most sense considering the constraints. For example, a computer science class may be the most practical use of the computer labs at Bara National. Since the school has such large class sizes, trying to coordinate additional computer lab time to integrate other subject matter might not be feasible. So a scheduled rotation of classes learning about computer science is the most practical option at Bara National. At Jinka Public, as another example, what makes the most sense is that the students would use the school's laptop for learning English vocabulary, because the keyboard's letter symbols correspond with the letters in the English alphabet. Thus, in order to access the laptop in a meaningful way, the Jinka Public students need to have some sense of English letters and words. Indeed, the dissertation's case studies could be told as stories of the practical ways that the students were using (and sharing) the school's computer technology.

So the dissertation has many different narratives. However, is there a common thread? At the outset of the dissertation, I introduced and discussed the phrase, Bangalore Challenge. As a brief refresher, the Bangalore Challenge is the nickname for a speech by President Obama that indicated how success in the twenty-first century will be determined by how well kids in the United States compete academically with kids in Bangalore and Beijing. In India, the message rang clear: Indian students, especially those living in India's large metropolises like Bangalore, have a perceived advantage in areas like science and math over students in a developed nation like the United States. Likewise, for many Indians, President Obama's speech signaled an important shift in thinking about the geography of global talent represented in the large scale of Asia's human capital.

The Asian continent's human capital potential is especially robust in India, as India is the world's largest democracy with one of the world's largest English speaking populations. The combination of democratic freedoms with multilingualism increases the likelihood that India's children shape tomorrow's global society (Guha, 2008). Thus, the challenge that Bangalore offers is not only a challenge to the United States, it is a challenge to the world. As Guha (2008) asserts this challenge, as represented in the city of Bangalore, is the Western world's recognition that India is more and more equipped to become a global superpower. The Bangalore Challenge, as proclaimed by Indian policymakers and the Indian press, largely portrays an urban India that educates the best and brightest students; students who are prepared to dictate the terms of success for the future. As many Indian scholars note, this is quite an amazing achievement for such a democratically young county that is a conglomeration of diverse languages and identities (Guha, 2008; Sen, 2005).

India's emergence as an economic and technological power in the global economy has led other countries, like the United States, to pay attention to its education system. Attention that Guha (2008) calls "equal parts wonder, admiration, and paranoia" (p. 718) about India's role in shaping future global relations. Therein lays another meaning of the Bangalore Challenge; the reaction to India's steady rise is a mixture of both wonder and paranoia that India's future generation will snatch up all the jobs worth having. In this regard, the Bangalore Challenge conveys a certain prestige and cultural capital associated with India's education system.

Although the Bangalore Challenge is a narrative unfolding in India, albeit in mostly urban areas like Bangalore, it certainly is not the complete story of the confluence of technology and education. This dissertation sheds light on the reach of the Bangalore Challenge within India. Bara National School's emphasis on logic, computer programming, and continual testing might capture the academic rigor associated with the phrase the Bangalore Challenge. Yet, Bara National does not fully capture the Bangalore Challenge as represented in the narratives of students who are working hard to learn English with a laptop, like at Jinka Public School and Komu Community School. Such narratives complicate the Bangalore Challenge. The Bangalore Challenge should be broadened further to include the students at Aadu International School who are working hard at developing their research skills as they prepare to become tomorrow's leaders and entrepreneurs. The Bangalore Challenge is a challenge to India, as well. That challenge is to understand the many different narratives that are part of technology's social construction in India's elementary schools.

Future Study

I now discuss future studies that would complement (and, possibly, challenge) these findings. I recommend studies that would further the field's understanding of the social shaping

of computer technology in elementary schools. I start with two future studies that are specific to India. One study connects with Indian policymakers' contention that issues within Indian education and schooling are fundamentally linked to India's democracy (ASER, 2010). Although this dissertation touched on the wider socio-cultural context in relationship to the Bangalore Challenge, another fruitful study would explore the extent to which the stabilization of computer technology in India's schools mirrors democracy. Bijker (2001) asserts the possibility of examining the democratization of technology vis-à-vis the way technology is negotiated in certain contexts. The idea is that in democratic societies, like India, the uses and stabilization of computer technology should have a democratic quality to them. The Komu Community administrators' vision of providing "equal opportunities" for their students by using the school's laptops is one example of technology's democratization from this current study.

Another study, though, could probe the relationship between India's computer technology and its democracy by starting with questions like: What computer technologies are commonly used in Indian elementary schools? To what extent do these uses for computer technology reflect democratic ideals and activities? To what extent does the negotiation (or stabilization) of the computer technology reflect democratic ideals and activities? The literature suggests that future empirical studies of technology's democratization, in local contexts and wider contexts, would be a promising line of research in uncovering how people use technological tools to achieve democratic ends (Bijker, 2001; Feenberg 1991, 1992). Indeed, such research could yield interesting findings in India, the world's largest democracy.

In my study, I theorized about the role of accessory social groups in stabilizing the meanings for each school's computer technology. While I grounded the theoretical underpinnings for accessory social groups in the specific context of Bangalore's elementary

school classrooms, there were accessory social groups, like parents, that could have been given greater consideration. Parents, especially parents in India, are usually highly invested into their children's education. Parents have a good deal of influence in also shaping the meanings for computer technology (Pal, 2009). Further research could probe the extent to which parents influence the social construction of technology in India's elementary schools.

Further research is also needed about accessory social groups. As I mentioned before, accessory social groups is an original concept that emerged from this dissertation's analysis. The concept is the dissertation's contribution to extending and refining SCOT theory. "Accessory social groups" is a theoretical concept that emerged from a process of grounded theory (Glaser & Strauss, 1967). This concept, though, needs further research to refine its definition and test its veracity in other contexts and settings outside the realm of Indian schooling.

Significance

This dissertation is significant in several ways. First, the dissertation is significant because of its methodology. This study is the first of its kind to apply SCOT theory to an examination of computer technology use in Bangalore's elementary schools. Before this study, SCOT theory was primarily used as a socio-historical theory for studying a technology's historical development across a wide range of context. Yet, in this study, I applied SCOT theory to a specific context, Bangalore's elementary school classroom. Using SCOT theory's methodological heuristics, I grounded this research in a systematic and disciplined inquiry. As the literature review in Chapter 2 explained, the field of research on technology uses in elementary schools, particularly in the Indian context, was lacking such a disciplined inquiry. This dissertation offers a model of such a methodological inquiry. The findings from the study are also ways to test SCOT theory. The inquiry also adhered to Glaser and Strauss's (1968)

notions about grounded theory as the dissertation added definitional dimension to SCOT theory in regards to "accessory social group." This is significant because it increases local knowledge and understanding about how Indian students are being prepared with computer technology with the support of school administrators or Public Private Partnerships.

Second, the dissertation has educational policy significance, especially within the context of Indian elementary schools. The dissertation findings speak to India's dual commitment to elementary education and technology; a commitment that finds its locus in Bangalore. Through legislation like Sarva Shiksha Abhiyan and the Right to Education Act, the Indian government continues to act on this commitment in order to convert "India's demographic advantage into a knowledge powerhouse" (MHRD, 2009, p.5). Yet, such legislation needs context and the instructive illustrations and insights that research offers (Light, 2009; Pal, 2009). Sarangapani (2003) contends that, "Observing and understanding the voices and practices of Indian elementary classrooms provides crucial insight into the universe of meanings that make up the school experience" (p. 247). This dissertation provides the context and illustrations for providing a deeper understanding for policymakers about the multiple ways that India's elementary school children are using computer technology. The dissertation's thick description also will help policymakers understand the meanings that schools assign to computer technology in meeting their educational goals.

Third, the dissertation is significant in technological ways. SCOT theory asserts that studies on the social construction of technology should go beyond simplistic conclusions about technology being shaped by humans and their societal structures. Rather, SCOT theory seeks to examine a technology's core and the way that core works in relationship to the specific context in which the technology is socially constructed. This dissertation is about the context of the

Indian elementary school classroom, specifically in Bangalore. The study shows how social groups in these classrooms constructed different meanings for their "core of technology" (Bijker, 1995, p. 281). So at Jinka Public the core of the school's laptop became a tool for a better life by learning English. The core of the Komu Community laptops was about empowerment and providing equal opportunities for students to become proficient in English. The core of Bara National's computer lab seems to relate more to logic and programming; whereas, the core of the Aadu International computer technology is knowledge ownership through research and presentation. These are narratives that illustrate the wide range of meanings that are constructed about "a technology's core" by teachers and students in Bangalore. The technological significance of this study parallels the educational significance as the uses for a school's computer technology are constructed into something considerable more meaningful than just the computer hardware, software, or knowing how to tap on a computer's keyboard.

In conclusion, I finish this dissertation by reflecting on a statement by Clifford Geertz about ethnographic work. Geertz (1992) said, "The aim of ethnography is to clarify what on earth is going on among various people at various times and draw some conclusions about the constraints, causes, hopes, and possibilities-- the practicalities of life" (p. 133). The dissertation's comparative case studies examine computer technology's social construction in fifth grade classrooms in Bangalore, India. My goal was to deeply describe and compare the four cases rather than try to generalize the role of computer technology in India. In meeting this goal, I have addressed the research gap about how computer technology use in India's elementary schools relates to socio-cultural contexts. In doing so, I have followed the recommendations of the field, including Indian scholars, through my inclusion of contextual descriptions. The case studies also provided support for the concept of accessory social groups.

This concept along with dissertation's thick description provides ways to clarify the complexity that is part of computer technology use in Bangalore's elementary schools. Furthermore, the dissertation provides new understanding of the contours of the Bangalore Challenge from the perspective of elementary school teachers and students using technological tools.

APPENDICES

Appendix A: Observation Protocol

The study's observation protocol is a list of questions to focus my field observations. I include questions for descriptive purposes (i.e. school setting context). I also include questions to investigate the second and third component of SCOT (interpretive flexibility and stabilization).

I coded the observation questions as follows:

- D stands for questions which aid in describing each setting
- IF stands for questions which examine the interpretive flexibility
- S stands for stabilization

I have different foci for each observation cycle. Each cycle will last between two to three days. I intend to observe 8 to 10 days at each school setting.

Foci 1: Computer equipment

- D - How many working computers are there at each setting (specifically for 5^{th} grade students to use)?
- D – Where are the computers located: in the classroom or in a computer lab?
- D - What kinds of software/hardware are installed/included with the computers?
- D - Is there Internet connectivity? If so, what kind (broadband, wireless)?

Foci 2: Computer usage

- D – How often do the student participants use the computers? (Hours and days per week)
- D - For what purposes are the computers being primarily used ("Drill and practice" software, creating multimedia, project based learning, etc.)?
- D – Are there assignments given which require computer use? If so, what are the assignments? What is the subject matter area?

Foci 3: Time

- D – Describe the instructional time with computers: How much is direct instruction? How much time for student practice?
- D – How is the teacher using the computer during the instructional time?

Foci 4: Interaction

- S – Describe any discussion/interaction which teacher and student participants have about computers.
- IF - What statements (about computers) does the teacher make? What questions does the teacher ask?
- IF - What statements (about computers) do the students make? What questions do the students ask?
- IF – What adjectives do the teachers use to describe computer use?
- IF – What adjectives do the students use to describe computer use?

Appendix B: Student focus group interview

Purpose: The purpose of the student focus group interview questions is to identify the students' interpretation(s) of using computer technology. The questions are designed to inquire about distinctions between the students' and teachers' interpretive flexibility when it comes to using computers. In the analysis of the interview, I will compare the student focus group transcript with the teacher interview transcript in order to distinguish the interpretations of each group and examine the degree of stabilization (how much similarity there is between the two groups interpretations of computer use in schools).

I coded the questions to show how each one aligns to the SCOT theory:

- IF stands for interpretive flexibility
- S stands for stabilization
- TF stands for technological frame

1. Why do you use a computer in school? (IF – perceived purposes of computer technology)

2. What does a computer help you do at school? (IF – perceived outcomes)

3. Do you ever have problems with using computers at school? If so, what kind of problems? If not, why not? (IF – perceived problems)

4. Follow up to anyone who answered yes to question #3: Who solves these problems? How do they do it? (IF – solving problems)

5. Why do you think your teacher wants you to use a computer? (IF – identifying the difference in interpretive flexibility)

6. What two activities would you choose to do on the computer (in school) if you had your own choice? (S – examining the stabilization of using computers in the school)

7. What two activities do you suppose your teacher would choose for you to do using the computer? (S – examining the stabilization of using computers in the school)

8. Do you think that your use of the computer in school prepares you for the future? If so, how? If not, why not? (TF – technological frame – identifying the future of computer technology)

Appendix C: Teacher interview

Purpose: The purpose of the teacher interview questions is to identify the teachers' interpretation(s) of using computers in schools. In addition, the questions are designed to inquire about distinctions between the students' and teachers' interpretive flexibility when it comes to using computers. In the analysis of the interview, I will the teacher interview with the student focus group transcript in order to distinguish the interpretations of each group and examine the degree of stabilization (how much similarity there is between the two groups interpretations of computer use in schools).

I coded the questions to show how each one aligns to the SCOT theory:

- IF stands for interpretive flexibility
- S stands for stabilization
- TF stands for technological frame

1. What do you understand as the purpose of using computers in school? (IF – perceived purposes of computer technology)

2. What does a computer help you do at school? (IF – perceived outcomes)

3. Do you ever have problems with using computers at school? If so, what kind of problems? If not, why not? (IF – perceived problems)

4. Follow up to anyone who answered yes to question #3: Who solves these problems? How do they do it? (IF – solving problems)

5. How do you think your students might answer the question about a computer's purpose in school? In other words, why do you think your students want to use a computer? (IF – identifying the difference in interpretive flexibility)

6. What two activities would you choose to do on the computer (in school) if you had your own choice? (S – examining the stabilization of using computers in the school)

7. What two activities do you suppose your students would choose to do (at school) when using the computer? (S – examining the stabilization of using computers in the school)

8. Do you think that your students' use of the computer in school is preparing them for a future job or career? If so, how? If not, why not? (TF – technological frame – identifying the future of computer technology)

Appendix D: Student Questionnaire

Purpose: The student questionnaire's purpose is to generate demographic data and identify students' perceptions about using computer technology. The questionnaire is adapted from the SLS study.

I coded the questions to show how each one aligns to the SCOT theory:

- IF stands for interpretive flexibility
- S stands for stabilization
- TF stands for technological frame

Directions: Please circle your responses.

1. What is your age? _____ (TF – demographic data)
2. What is your gender? Boy or Girl (TF - demographic data)
3. Which of these items do you have in your home (circle all that apply):
   A. Radio B. Television C. Computer D. Cell phone E. None of the above
   (TF – demographic data)
4. Which of these is used in your home to cook food?
   A. Firewood B. Kerosene stove C. Gas D. Hot plate E. Other: _____
   (TF – demographic data)
5. What kind of vehicle(s) does your family own?
   A. Motorcycle B. Scooter C. Bicycle D. Car E. Other: _____ F. None of the above
   (TF – demographic data)
6. How many books (not counting magazines or newspapers) are in your home?
   A. 1-15 B. 15 – 40 C. 40 – 100 D. 100 - 200 E. Over 200 F. Zero
   (TF – demographic data)
7. How many rooms are in your home?
   A. 1-2 B. 3-4 C. 5-6 D. 6-8 E. Over 8
   (TF – demographic data)
8. What items do you own or have?
   A. Bicycle B. Book bag C. An iPod D. A cell phone E. None of the above
   (TF – demographic data)
9. What do you believe is the most important thing which you can do on the computer?
   A. Search for information B. Create movies/multimedia C. Listen to music D. Play games
   E. Process information faster F. Communicate with friends (email) G. Learn basic skills
   H. Other: _____ (please specify)
   (IF – Perceived purpose)
10. What do you believe your teachers would say is the most important thing which you can do on the computer?
   A. Search for information B. Create movies/multimedia C. Listen to music D. Play games
   E. Process information faster F. Communicate with friends (email) G. Learn basic skills
   H. Other: _____ (please specify)
   (IF and S – perceived purposes and stabilization of those purposes)

11. What subject matter do you learn best *when using a computer*?
A. Reading/Literacy B. Maths C. Science D. Social studies E. Second language
F. Other: _____ G. None
(IF – Perceived purpose)

12. What subject matter do you learn best ***without*** using a computer?
A. Reading/Literacy B. Maths C. Science D. Social studies E. Second language
F. Other: _____ G. None
(IF – perceived problems)

13. I enjoy using a computer in school.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – Perceived outcome)

14. I am motivated to learn in school when I use a computer
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – Perceived purpose)

15. I work better with other classmates when using a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – Perceived outcome)

16. I know how to use a computer for school related purposes.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – Perceived purpose)

17. My school work and home work are improved because of my computer skills.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – perceived outcome)

18. I do better in math and science when using a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – perceived outcome)

19. I do better in reading, social studies, and second language when using a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – Perceived purpose)

20. I learn more from the computer than from a teacher.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – perceived outcome)

21. I am a better student because of computer technology.
Strongly agree Agree Undecided Disagree Strongly disagree
(IF – perceived outcome)

22. What kind of job would you like to have in the future? (Please write a short answer)

_____

(TF – demographic data)

Appendix E: Teacher Questionnaire

Purpose: The teacher questionnaire's purpose is to generate demographic data and identify teachers' perceptions about using computer technology.

I coded the questions to show how each one aligns to the SCOT theory:

- IF stands for interpretive flexibility
- S stands for stabilization
- TF stands for technological frame

1. What is your gender? Male or Female (TF – demographic data)
2. To which age group do you belong?
   A. Below 25 B. 25-29 C. 30-39 D. 40-49 E. 50-59 F. 60 or above
   (TF – demographic data)
3. How many years of teaching experience do you have?
   A. Less than 1 B. 1 -3 C. 4-6 D. 7-10 E. 11-15 F. 16-20 G. More than 20
   (TF – demographic data)
4. What is your highest level of education?
   A. Some college B. Bachelor's degree C. Master's degree D. Ph.D. degree
   E. Other: _____ (please indicate)
   (TF – demographic data)
5. How often do you use a computer at school? (If you answered A, B, or C, please move question 6 and 7)
   A. Daily B. Three times a week C. Once or twice a week D. I do not use a computer
   (TF – demographic data)
6. Where did you learn how to use computer technology in your teaching?
   A. Self-taught B. Professional development at school C. College or university
   D. A colleague or colleagues E. Other: _____ (please indicate)
   (TF – demographic data)
7. What is your primary purpose for using a computer at school?
   A. Communication (email) B. Book-keeping C. Creating media presentations (PowerPoint)
   D. Entertainment (games) D. Research E. Other: _____ (please indicate)
   (IF – perceived purposes)
8. Do you have a computer at home? Yes or No (If yes, please answer question 9)
   (TF – demographic data)
9. What is your primary purpose for using a computer at home?
   A. Communication (email) B. Book-keeping C. Creating media presentations (PowerPoint)
   D. Entertainment (games) D. Research E. Other: _____ (please indicate)
   (TF – demographic data)

10. What do you believe should be your students' primary purpose for using a computer at school?

A. Communication B. Use software to practice skills C. Create multimedia
D. Entertainment (games) D. Research (searching for information) E. Other: _____
F. I do not believe my students should use computers

(IF and S – perceived purposes and stabilization of computer technology)

11. What subject matter do your students learn best when using a computer?

A. Reading/Literacy B. Maths C. Science D. Social studies E. Second language
F. Other: _____ G. None

(IF – perceived outcomes)

12. What subject matter do your students learn best ***without*** using a computer?

A. Reading/Literacy B. Maths C. Science D. Social studies E. Second language
F. Other: _____ G. None

(IF – perceived problems)

13. The use of computers has helped to motivate my students

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

14. The use of computers has increased the level of student interaction and collaboration.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

15. The use of computers has positively impacted my students' learning and achievement.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

16. Most of my students can capably use computers at an age-appropriate level.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

17. The use of computer technology has improved the quality of my students' work.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

18. The use of computer technology can enhance school subject matter like math and science.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

19. The use of computer technology can enhance school subject matter like reading, social studies, and second language?

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

20. Students learn more from a computer than from a teacher.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

21. I am a better teacher because of computer technology.

Strongly agree Agree Undecided Disagree Strongly disagree

(IF – perceived outcomes)

22. What is the most important thing that you would like your students to know about using a computer? (Please write a short answer)

_____

(IF – perceived purposes)

Appendix F: Digital Image Foci

Purpose: I will capture digital images of each school setting in order to provide a visual source of data for the technological frame of the study. I will not capture images of student or teacher participants. The digital image foci include:

Focus 1 – School building and grounds (i.e. playground equipment)
Focus 2 – Classroom and/or computer lab
Focus 3 – Examples of computer hardware/software at each school setting
Focus 4 – Other ICT (if any) at the school

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