

SUSTAINABLE DESIGN FOR PRIMARY GRADE STUDENTS IN LATIN
AMERICA TO LEAPFROG INTO THE TWENTY-FIRST
CENTURY FOR ECONOMIC
DEVELOPMENT

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VITA

Donna Elizabeth Haynes, adopted daughter of Lyle E. and Korky Haynes, was born October 7, 1967 in Pusan, South Korea. She began elementary school in Bad Kissingen, West Germany, continued at Tehran American School in Tehran, Iran and finished high school in El Paso, Texas from Eastwood High School in 1985. She began college at the University of Texas at El Paso, where she received a Bachelor of Arts degree in Political Science and a Master of Art degree in Metals in 1996. She began the Post Baccalaureate program in Industrial Design at Auburn University in 2004 and received a Bachelors of Environmental Design in 2005. She was inducted into the Auburn University Alpha Theta Chapter of Tau Sigma Delta Honor Society of Architecture and the Allied Arts in the Spring of 2005. She was accepted to the graduate program in the summer of 2005, where she began her Masters of Industrial Design program in Costa Rica as part of a collaborative with the University of Georgia at Athens with their Landscape Architecture Department. She finalized her graduate studies as an assistant to the Collaborative Traveling Studio in Ireland. She was awarded four Graduate Teaching Fellowships and one Research Assistantship.

THESIS ABSTRACT

SUSTAINABLE DESIGN FOR PRIMARY GRADE STUDENTS IN LATIN
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Research has shown that the education of primary grade students in Latin American countries is crucial to their economic growth. Although enrollment gains each year and most Latin American countries boast of literacy rates in the ninetieth percentile, education is substandard; repetition rates are high and expensive, and statistics are not accurate.

While technology “leapfrogs” into developing countries by creating Internet connections where even landlines for telecommunications have not been established; business turns toward P.K. Prahalad’s well-received book, *The Fortune at the Bottom of the Pyramid* that examines the Third World as an emerging market. Meanwhile, designer a can meet the challenge of problem solving for human factors politically, socially, culturally, economically and sustainably.

This thesis examines the reasons and methods used for developing an electronic textbook designed for Latin American primary grade students. It will outline a system for improved education through technology and product design where electronic textbooks can enhance the learning experience, track results, and reduce waste and distribution problems. Components are condensed to reduce gratuitous functions in favor of durability and decrease the added cost of production. Interactive and adaptable modular lessons reduce the repetition rate of students by including a skill assessment, in which, the results are monitored by a central database for a systematic and accurate tracking. Full development allow teachers to modify lessons for their regional needs as well as reducing the training of teachers for students who attend multi-grade classrooms or are unable to attend school at all. Though developed for underprivileged grade school children in Latin America, the platform can extend to primary grade students worldwide, home-schooled children and illiterate adults.

Style manual or journal used: APA Standard Guide, Fifth Edition

Computer software used: Microsoft Office: mac 2004, Student and Teacher Edition

Adobe Illustrator CS2

Adobe Photoshop CS2

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CHAPTER ONE

DESIGN FOR NEED

Since the industrial revolution, industrial design became a democratizing tool allowing the masses to enjoy products that could elevate one's life through convenience and aesthetics. Presently industrial design is expanding to mean a great many things. In the beginning however, it was the artistry and constructing of tools which man needed to function and navigate through his environment. Craftsmen and artisans were the innovators of their societies, gradually refining their designs to reflect the priorities of their time. The industrial revolution made it possible to manufacture these items more quickly, more inexpensively and more equally for modern society. Mass production created new disciplines to consider the effects of mechanization on society. Those questions include the economies of scale, variety, efficiency and cost. This, in turn, created new focus on the nature of human interaction with the machines. Since then, Christopher Nemeth refers to human factors and ergonomics as to "inform the process of creating the operational environment." Ergonomics and human factors are needed to serve a complimentary role to design and engineering in a human-made environment (Nemeth, 2004).

According to the Institute of Design's industrial design methodology, one of the primary concerns of the industrial designer is the human aspect of design.

Human-centered design includes four facets of human factors relative to design; the physical, cognitive, social and cultural factors involved with human interaction with products, systems, organizations and messages (Institute of Design, 2004). It is a focused study included in the disciplines of design, social sciences, engineering and business. This methodology allows the Industrial designer to study the way people work and how they live through research of their physical capabilities, cognitive functions, cultural background and social standing. Ideally, a designer would like the user to develop an experience with that which he designs.

If human factors can be thought of as a much broader concept than only the aesthetics and cognitive associations used in the methods of design and can involve the political, economic and cultural needs of people, then innovation can also expand its definition as “a planned and systematic program for change” (Messina, 1999). Innovation can be applied to the single product, as an industrial designer would as well as the application of an entire system that to introduces a “chance that creates a new dimension of performance” (<http://en.wikipedia.org/wiki/Innovation>).

Nowadays, with the innovations of technology and the media, some of the inequalities of developing nations and the industrialized nations have closed. Some developing countries enjoy the innovations of wireless communications and satellite television. However, as technology and innovations of the developed world are donated to those in need, they are received without the empowerment, autonomy and critical skills needed to sustain these gifts. It has been a criticism of the industrialized world to give philanthropically. Charity is needed, but rarely solves the problem (Prahalad, 2005).

Developing nations in this context refers to the two-thirds of the world's population (Prahalad, 2005). According to wikipedia.org, the outdated and derogatory connotation of "Third World" has led to the use of "developing nation" to refer to nations low in the United Nations Human Development Index independent of their political affiliation. It is also referred to as the "Global South," "least developed countries," "two-thirds world," "emerging markets" and the "majority world." However termed, it relates to the world's four billion poor living on less than \$2 per day (Prahalad, 2005).

As globalization prevails, technology creates a desire for products that were once unknown or unavailable to developing nations. It is possible now for corporations to tap into these markets which P.K. Prahalad terms "the fortune at the bottom of the pyramid" (BOP) in his book of the same name. It is not acceptable to manufacture substandard merchandise and sell it to the poor at a cheaper price for two reasons. First, for the poor, it is even more important that quality products and services are available to them. Their hard earned money is not disposable income and quality and longevity are expected in a product. Poverty is synonymous with a lack of education; therefore, quality service and a high regard for user-friendliness are further emphasized. Secondly, it is vital that the two-thirds of the world's population given "emerging market" status do not adopt the disposable lifestyle that the industrialized countries have. If each person in the United States generates 4.62 pounds of waste per day, then the adoption of these habits multiplied by the 5 billion potential consumers will have a detrimental result to the progress of a higher living status (Prahalad, 2005). This majority of humanity should be the concern of industrial designers.

The problems of the developing world are discussed in countless political arenas, in business contexts and as a concern for designers, yet no solutions have been made. Victor Papanek's *Design for the Real World* was published in 1972. The Royal College of Art held a conference in 1971, and the International Council of Societies of Industrial Design (ICSID) held an international conference in 2003 to discuss the seriousness of "design for need." Currently, the Industrial Designers Society of America (IDSA) has initiated "Design About," in collaboration with Hewlett Packard to gather designers from around the world to discuss the "world's other 6 billion people and the new methods and processes they could develop when designing for this unserved group" (IDSA, 2006).

The possibilities of reaching the bottom of the pyramid and fulfilling their needs are daunting and complicated. As donors or designers, our interests can be in complete opposition to theirs, well meaning or not. There are valid arguments for "foreigners" not being able to design for people of different cultures even in developed countries. There is the question of donating sustainable solutions to developing nations. The reality remains that one of the solutions is the eradication of poverty, a complicated matter of its own. Therefore, the novel skills of the industrial designer, such as the original approach to human factors, the application of detail in a system of operations, the connection to the interests of business, the aptitude to communicate visually and the ability to innovate are needed to generate solutions. It is understood in the realm of design that human factors include, ergonomics, semiotics, and observation of user-behavior and physiological factors including the human perception of aesthetics; however, on broader yet more basic level, human factors include the world which we have fashioned for ourselves. While persuading designers to consider the two-thirds of the world that go without, it is

necessary to redefine “human factors” to include; political, cultural, economic and environmental. Edward Woodhouse and Jason Patton assert that political, cultural, economic, and environmental factors always are embedded in design, thus producing far-reaching implications. Hence, a more comprehensive formulation of the concept of design for the Third World should begin from an understanding of the complex interrelationship between design and social, cultural, and political factors (Amir, 2004).

Need for Study

There are three reasons why the present is a timely opportunity for designers to act for great humanitarian, social and monetary returns. In the age of globalization, there is a progression for developing countries to adapt industry, while industrialized countries move towards technology and service industries. Manufacturing is moving to developing countries while “the decision makers” remain in the US. Secondly, gender disparities have lessened, democratic values have expanded and technology has grown to reach the corners of the world. In Latin America strides have been made to reach those in need with progressive social programs through the aid of computers.

Lastly, developing countries (and developed countries) need to be prepared to manufacture in the most sustainable ways for our economic and global health. This occasion to take action while events are still in flux is an indication that there is a need to study design for developing countries in ways that will benefit those who need better products and a world that needs alternative ways to manufacture and distribute.

“The fall in manufacturing employment in developed economies is a sign of economic progress, not decline” (“Manufacturing Employment,” 2005). The

disappearance of manufacturing jobs has not been caused by a mass substitution of Chinese exports for American, but in “rich” countries, such as the US, Great Britain, France, Germany and Japan, new technology has replaced low-skilled labor. In fact, in the United States, manufacturing jobs now account for less than 10% of total jobs.

Manufacturing jobs in the US have been replaced with technology to boost productivity.

Production has shifted from labor-intensive products to pharmaceuticals, research and development, design and marketing and they have all stayed home, as low-skilled jobs move off-shore (“Manufacturing Employment,” 2005). For example, in April of 2005, Lenovo, a Chinese company bought the PC division of IBM. This instantly moved Lenovo from the ninth largest maker of PCs to the third. The interesting aspect of the acquisition is that along with the PCs went the management. Five out of ten top-level managers are American. The CEO is American and the new headquarters was moved to Purchase, New York, from Beijing (Maney, 2005).

Poverty in Latin America gets an overhaul. In Brazil, a government subsidy called *Bolsa Familia* or “family fund” was a scheme set up in 2003 that provides a basic income to 7.5 million of Brazil’s poorest families, or 30 million people. It is a conditional cash transfer of up to 120 reais (@\$52) a month to poor families (of five or more). Mexico began the first large-scale program that was called *Progresas*, and is now *Oportunidades*. The conditions for which these payments are made vary from country to country. Female heads of household receive payments because they are more likely to spend the money on their children than the male. If a child misses more than 15% of classes or fails a grade twice, payments are suspended. The family must make regular visits to health clinics. Something similar exists in Argentina and Chile. This is progressive. Before now, who

received benefits was determined by corrupt and fickle governments. The middle class took advantage of social benefits. Rodrigo Garcia Verdu, a researcher at Mexico's central bank, says that it is possible now to crunch numbers on a massive scale and the program is better than any previous social spending in reaching the people it is intended to reach. It is also possible to evaluate the effects ("New thinking about an old problem," 2005).

It becomes abundantly clear that much of our manufacturing and the development of Third World countries will wear even greater on the Earth's resources. Of the two main engines for the world, the United States and China (also the two biggest oil consumers) the US remains the largest consumer of oil, using one-quarter of the world's output, while China single-handedly accounted for one-third of the growth in oil demand since 2000. "This effect is exacerbated by the fact that the economies that are currently growing the fastest tend also to be the least efficient users of oil. To produce one dollar of GDP, emerging economies use more than twice as much oil as developed countries" ("The oilholics," 2005).

Objectives of Study

As illustrated in the Introduction and the Need for Study, the solution to designing for those who have the greatest need calls for a rigorous set of criteria. Design as policy to create new commodities can create an entirely new economic status for a country. Through secondary research, problems and solutions can be defined for the people of developing countries while involving all of the skills of industrial design and not thwarting the autonomous rights of those being "helped." Research objectives should clearly outline the need for design from the viewpoint of the user. The user is defined as

the disproportionately large number of poor from Latin America. This focus group should be further explored by identifying whom and to what extent these people are poor and what their needs are.

When this group of users is clearly defined, the next step will be to illustrate the environment that they live in, including their economic status, their cultural restraints and freedoms, their environmental resources and their political environment. This study will gather these statistics to clearly define the user and his needs. Through these criteria, an illustration of what type of products they already use and what type of products they might need can emerge.

By understanding their culture including their religion and language, we can discount any products that may be offensive, gratuitous or irrelevant. Researching environmental resources and developing products that are defined by these constraints will inevitably help by allowing developing countries to maintain their own independence and maintain the products in a sustainable way.

The political and economic climate can define how the product developed can benefit the bottom of the pyramid. The political and economic climate will also examine how this product is acquired, either through the possibility of government subsidies or purchase. It is also important to illustrate the need for grassroots campaigns to develop a sense of independence and ownership. The objectives of this study is to gather research for the political, economic, cultural and social aspects of the poor in Latin America with the outlook towards a new product adhering to the criteria of human factors and innovative solutions that industrial designers have to offer.

Literature Review

Initial examination of the studies for developing countries resulted with an article featuring a mechanical engineer from Massachusetts Institute of Technology (MIT) who has been working in third world countries such as India and Haiti. Professor Amy Smith says, “A lot of people look at where technology is right now and start from there, instead of looking at the absolute functionality, if you go back to the most basic principals, you can eliminate complexity.” She works on a first hand basis with the culture that she is helping. For example, In Haiti, thousands die from annual flooding which also causes massive deforestation. There is a simple solution of extracting the juice from sugar cane, which is plentiful, and placing the remaining fibers, called bagasse in a sealed 55 gallon drum. The bagasse carbonizes from a lack of oxygen. It is then bound with a cassava-root porridge to create a charcoal that can be used to cook. This process is also adapted for India where cow dung is used as cooking fuel and the smoke inhaled is the primary cause of death for children (Dean, 2004).

The Fortune at the Bottom of the Pyramid by C.K. Prahalad, a professor of Business Administration and Professor of Corporate Strategy and International Business at the University of Michigan Business School, gives merit to the world’s poor as a viable investment, making it fashionable and lucrative to focus on the needs of the world’s four billion poor. His research focuses on the corporate strategy and the role of top management in diversified multinational corporations; however, in the twelve principles of innovation that he prescribes to solve the challenges of the bottom of the pyramid (BOP) he describes the skills and duties of industrial designers. His research supports not only that industrial designers are needed to design for the BOP, but supports that the poor

are four billion strong as a market. This is encouraging because it makes it viable for companies to produce and distribute products where there is profit involved.

The twelve principles, which Prahalad describes, begin with reducing the price of products and services, but not just lower prices. It is about reworking the price-performance envelope. He describes the use of GSM handsets in India. GSM handsets used to cost US\$1,000 in India. The price decreased to US \$300, which improved sales; however, when 100 free minutes were offered with a down payment of US\$10 and monthly payments of US \$9.25, the company Reliance, received one million applicants in 10 days. Of course, the performance associated with the price is important and it did not change. During the last quarter of 2003, India was adding 1.5 million new subscribers a month.

Innovation requires hybrid solutions. The market at the BOP needs advanced and emerging technologies that are creatively blended with the existing and rapidly evolving infrastructures. They cannot be watered-down versions of technology for the developed markets. Sometimes they call for the most advanced technologies creatively combined with existing and evolving infrastructure. Unilever, a worldwide consumables company, developed a patented process on retaining iodine molecules in table salt. In India, under the harsh conditions of transportation and Indian cooking methods there is a lack of iodine in children that leads to more than 70 million Indian children suffering from iodine deficiency disorder (IDD) causing mental retardation.

As a prerequisite for making an economic case of the BOP, solutions need to be easily adaptable, scalable and transportable across countries, cultures and languages.

Because of low profit margins and strict price-performance guidelines, the basis for returns on investment is volume.

All innovations must focus on conserving resources throughout product development. US water consumption per capita is around 1932 cubic meters per person per year. In China, it is 491 cubic meters and in India, 640 cubic meters. Scarcity has not altered usage patterns.

Designers need a deep understanding of functionality, not just form. Recognizing that the functionality required in products or services in the BOP market might be different from that available in the developed markets is a critical starting point. India has 5.5 million amputees and about 25,000 to 30,000 are added each year. The Jaipur Foot, invented by Mr. Ram Chandra and Dr. P.K. Sethi is an example of this. Patients must walk long distances (8-10 km per day) and travel from all over to get treatment but cannot afford frequent replacement or hospital visits. This prosthetic must be custom fit in a day by a layperson. At best, they can afford \$50. The Jaipur Foot must endure rigorous demands because regaining the ability to walk does not mean much if the amputee cannot squat on the floor, work in the field, walk on uneven ground and not wear shoes. An average workday may consist of standing in water in paddy fields for at least eight hours a day and the Jaipur Foot is able to meet these demands for US \$30.

Process innovations are just as critical in BOP markets as product innovations. Manufacturing is susceptible to the prevailing conditions. A logistics infrastructure cannot be assumed when designing and manufacturing in developing nations, especially in rural areas. However, innovations made for the process of manufacturing and distribution is a critical step in making products and services affordable for the poor.

Deskilling work is critical. As in the example of the Jaipur Foot, untrained workers are necessary to the fitting of prosthetics to amputees. In most BOP markets there is a shortage of talent so training must adhere to the abilities of unskilled labor and products need simple and understandable usages.

At Cemex, a concrete supplier in Mexico, a group of three women can start a savings program where in 76 weeks they can save enough to buy a bathroom or a kitchen. Cemex provides technical assistance, such as architects and skilled technicians with advice on how to “do it yourself”. Before these groups of homeowners even began the savings program they knew what kind of a room they could add, including its size, appearance, and materials needed to build it, including cement, steel, paints, tools, and so on. Cemex holds all of the necessities in a package in storage until the customers were ready. This company has helped more than 300,000 families.

Education of customers on product usage is key. New and creative approaches are needed to meet the challenges of educating semiliterate groups on the use of new products in “media dark” zones.

Education is a prerequisite to market development. HLL, a subsidiary of Unilever, discovered that more than 2 million deaths each year caused by stomach disorders in children could be prevented by washing one’s hands. Incidentally, it could also increase its volume of soap sold. HLL sent teams into the schools to teach children of the dangers of dirty hands and proper hand washing procedures. The children were then able to pass this information back to their homes.

Products must work in hostile environments including noise, dust, unsanitary conditions and abuse and be robust enough to accommodate the low quality of

infrastructure, such as electricity (wide fluctuations voltage, blackouts brownouts and water, particulate, bacterial and viral pollution).

Systems have been developed to eliminate pollutants from water, from simple filters to complex systems. However, purified water from these systems is still subject to contamination. Systems distilling purified water did not consider the unhygienic containers and unclean hands that it is exposed to afterward.

Research on interfaces is critical given the nature of the consumer population. The BOP is an opportunity for innovative approaches such as, iconic, color-coded, voice activated, fingerprint and iris recognition (biometric-based) interfaces because many customers are first-time users of products and services. The learning curve cannot be long or arduous. The heterogeneity of the consumer base is vast in terms of language, culture, skill level and prior familiarity.

Elektra in Mexico caters to BOP customers and has also introduced fingerprint recognition as a basis for operating the ATMs in its stores so they do not need to remember a 9 digit code.

Innovations must reach the consumer. Distribution to the highly dispersed rural market and a highly dense urban market at the BOP is critical.

Avon has been extremely successful in using direct sales in Brazil. Avon has built a \$1.7 billion business based on direct selling. Avon representatives become experts who provide guidance to customer, mini suppliers, distribution channels, and providers of credit.

Product developers must focus on the broad architecture of the system, i.e. the platform, so that new features can be easily incorporated. The feature and function evolution in BOP markets can be very rapid (Prahalad, 2005).

These are all inherent duties of the industrial designer. These are tasks that are considered whenever a designer is given a new project. Furthermore, the industrial designer has no specific agenda as does a manager or a politician.

It is an industrial designer's role in society to take an innovative approach to solving the problems of human interaction with manufactured products. An industrial designer's product is differentiated from the work of engineers and artists by their focus on the human aspects of creating a functional product. Moreover, industrial designers can use their skills of problem solving, innovation, engineering, manufacture, and creating products with user-centered design research and their training in the manufacture, packaging, distribution and use of materials while focusing on the four billion of the earth's population who live in poverty. The "ideology" of design as problem solving drives designers and design scholars to think about how design can contribute to helping Third World societies (Amir, 2004). Victor Papanek, the writer of *Design for the Real World* and industrial design professor asserted, "Design must become an innovative, highly creative, cross-disciplinary tool responsive to the true needs of men [and women]." Papanek's notion of design for the Third World was quite novel at a time when most designers in industrial, developed countries were concentrating on serving profit-oriented industrial corporations, celebrating a high mass consumption society (Amir, 2004). This is an age of overwhelming branding and marketing of the latest technology. Disposable products such as electronics, appliances and even automobiles

have become the norm. People throughout the world who need more of the basics of a comfortable and safer life and cannot afford these products need quality, necessary and conscientious products not only to fulfill their current needs, but to facilitate the development of Third World countries to First World countries.

Politics and economics are symbiotic. The political economy of design begins from the notion of design as a process of creating artifacts that have economic value (Amir, 2004). Langdon Winner's (1995) concept describes a political ergonomics policy that enables industrial interests to influence design policy. It builds constraints that hinder local people from putting their needs, desires, and interests into the policy. Therefore, political strategy needs to implement fairer practices to allow lay people to influence policy (Amir, 2004).

Developing nation's governments have shown an increasing awareness of design. There is the establishment of design centers and institutes, and the growing number of design schools with the government's support in Third World countries. The endeavors to bolster design activities in Third World countries are motivated by the idea that design is a strategic tool for business and commerce, and thus important for economic growth (Amir, 2004). The important feature of design policy is to encourage those corporations to utilize design more intensively in product development and innovation processes. Today, industrial-oriented policy in the form of design promotion centers, design institutes, and the like is growing in a number of countries (Amir, 2004). The Malaysian government established the Malaysia Design Council in 1993 to determine the best use of design by Malaysian industry. The Indonesian government created the Indonesian Design Center in 1995 with assistance from the Japan International Cooperation Agency and the

Japan Design Foundation. In the Philippines, the Product Development and Design Center of the Philippines was created by the government to promote industrial design as a tool for improving the quality and competitiveness of Philippino products. The Thai government has created the Office of Product Development & Design for Export. In India, design policy is implemented through the establishment of the National Institute of Design, which puts an emphasis on educating designers and serving industry. In Colombia, there exists *Artesanías de Colombia*, in Cuba there is an *Oficina Nacional de Diseño Industrial* (National Office of Industrial Design). In Mexico, the government created the Mexico Design Promotion Center, whose tasks are similar to those of design institutions elsewhere. In Brazil, the Brazilian Design Center has done an excellent job of fulfilling industry's needs in the industrial area of Sao Paulo. SABS Design Institute fosters the economic and technological development of South Africa.

The substantial size of the Third World's foreign debt to First World financial institutions is a very serious problem that Third World countries face because it severely burdens their economies and shapes the Third World's economic dependency on the First World (Amir, 2004). The important feature of design policy is to encourage those corporations to utilize design more intensively in product development and innovation processes. Economic interests characterize the foundation of design policy in Third World countries. It treats design as a strategic tool for industrial competitiveness. The subjects of the policy are industrial corporations and aimed at improving industrial competitiveness (Amir, 2004).

The advent of CAFTA (Central America Free Trade Agreement) and NAFTA (North American Free Trade Agreement) allows for freer outsourcing of manufacturing

for the United States and can be an advantage to the development of newly developing countries; however, it can be detrimental to the independence and foreign debt of developing countries. It supplies jobs for newly industrialized countries and allows for cheap labor and lower prices for the developed nation's consumer. The argument is that design should be done "*in* the periphery and not *for* the periphery as the result of some kind of benevolent paternalistic attitude of the center to these countries" (Fathers, 2003). Presupposing that western cultures, i.e. post-industrialized countries are saturated with products, is it not necessary for designers to essentially return to the basics of design, and produce innovative and user-oriented products for those who *need* them the most?

Evidently, Third World governments know the benefits of design to their political economy, but even they are using it to stay competitive with the rest of the world and overlooking their own. How does a business make designing for the bottom echelon of the socioeconomic ladder a viable option for themselves? Corporations such as Proctor and Gamble have begun to focus on the Third World as a burgeoning market. Whereas, the United States, Asia and Europe's markets are saturated, the Third World is not. Manufacturers will be able to make and sell quality products at affordable prices because their consumer market just opened up to two-thirds of the world.

The institutionalization of human-centered design policy can be characterized by three principles, which replace the "mainstream" mode of design policy. First, a human-centered design policy is directly oriented toward people's needs and interests. Within this orientation, design is treated as a social and cultural tool for creating a better life for Third World societies in accordance with their social and cultural infrastructures. Second, the targeted users of human-centered design policy, as expressed in its name, are people.

Here, the function of design is not limited to producing physical artifacts, but is extended to enhancing sociality and improving equity in least developed nation's societies. And third, although the role of government in human-centered design policy remains important, the participation of many stakeholders such as design practitioners and academicians, and local communities, plays a pivotal role in influencing design policy outcomes. This participatory model of design policy politically empowers design to be utilized more effectively in dissolving the predicaments of Third World societies (Amir, 2004).

While designing for a different culture, the designer must take into consideration and respect the needs of that culture. Papanek describes the Japanese *tatami*, a floor mat consisting of rice straw packed inside a woven rush. Their primary purpose is to act as a sound barrier and filter dust in traditional Japanese homes. Beyond these mats, the Japanese home consists of fragile, sliding paper walls which both contribute to the overall acoustics which influence the design and development of Japanese musical instruments. He further describes the inability to place rice straw mats into an American home because of the high cost of replacing them (more dirt is tracked inside because of the different shoes worn by Americans) or placing a grand piano in a Japanese home (Papanek, 1984). This is only one example of design needing a cultural context.

Richard Buchanan's work reminds us of the ontological meaning of design for human dignity and human rights: "Design is not merely an adornment of cultural life, but one of the practical disciplines of responsible action for bringing the high values of a country or a culture into concrete reality...[D]esign is the way we create all of the artifacts and

communications that serve human beings, striving to meet their needs and desires, and facilitating the exchange of information and ideas that is essential for civil and political life...design is the way we plan and create the complex wholes that provide a framework for human culture—the human systems and subsystems that work either in congress or in conflict with nature to support human fulfillment” (Amir, 2004).

The social and economic problems of Third World societies cannot be solved solely through the materiality of design. The designing and production of substandard products by charitable designers and the use of local materials cannot solve the problems of the Third World (Amir, 2004).

The final aspect that must be involved when dealing with human factors is the environment. It is important for the US as a post-industrial country, while exporting our industry to developing countries that we also export our hindsight. We now have the advantage of 20/20 hindsight of all the environmental and economic mistakes that post-industrial countries have made. When referring to the sustainability of man and furthermore the environment it is necessary that government policy and business policy adhere to what will best suit the preservation of our natural resources. It is our responsibility as designers to design sustainable products for people and countries that do not have the resources to become as “disposable” as we are today.

Every quality of the human condition can be realized by designing products with the real needs of humans as an objective. By producing products in ways that are sustainable, reliable and durable for the communities they are made, industrial designers will be challenged on the most fundamental and innovative level. Businesses can profit

with newly found markets. People can aspire to be stakeholders in their own political and economic communities. Nations can prosper within their own independent identity and participate on a global level.

Assumptions

There is an assumption that people in developing countries want help. However, there are two ideas that may prove the opposite. The first is that they may not want someone from another country thinking that their way of life is not good enough and how can foreigners “help” when perhaps they have a sense of pride of their own. The second idea is that they do not want incremental change, for example, a household water reclamation unit would not satisfy their needs, perhaps they would rather a full water reclamation plant supplying water to an entire region.

As far as government and business are concerned, it is assumed that they want to help also. However, their priorities may be with, for example, “power” and “bottom line,” respectively. It is also assumed that if a plausible proposition were presented to them where the needs of the people could be met while a minimal profit for the manufacturers were met that the “good nature” of mankind would prevail.

Since government and laws were created to protect us, they should do just that. To be sovereign and benevolent it is necessary to take care of the people, and when business can help they can be a priority as well; however, when their needs and profits dictate the welfare of the people it is governments’ duty to protect the people that they govern.

For humanity to prosper, they need the basics of life, food, shelter and water. When these basic needs are provided it is the capability of mankind to work harder, think more intelligently and create beyond what is already established.

Each civilization wants to leave its own legacy. In relevance to this thesis, as people progress, they do not want to destroy the earth for their own good. People want to preserve “quality of life” for their grandchildren. However, these values are not always accomplished and most often discarded for convenience.

Scope and Limitations

The scope of this research includes Latin America and the Caribbean and focuses on the product and service needs for the education of primary school children. Research in public education policy, economic status and cultural environment was obtained through secondary literary research and Internet research. This is one of the limits of the study. The scope will not cover special needs products for inclusive design or universal design.

The Problem

Latin America and the Caribbean (LAC) are classified as a middle-income region. It does not reflect the growth that Newly Developing Countries, as those in Asia, India, China and South Korea do (Wolff et al., 1994). Some of the population lives beyond our dreams in wealth and prosperity. However, most live far below the “middle-income” status. Urban areas are plagued with slums and the rural areas can reflect more of what we envision as a third world environment. Though some areas are lacking in the context

of infrastructure and technology, it is available. All the countries in the LAC are democratic republics with the exception of Cuba.

The problem is that even with the growth of universal enrollment of primary school students and literacy rates sometimes topping those of the United States, the statistics are unreliable. Children are deemed literate by passing the first five years of schooling without gaining the skills of comprehension. There are too few textbooks, teaching materials, teachers, lack of teacher training and classrooms for consistent learning across socioeconomic lines. To create a sustainable solution to poverty, instead of giving the poor consumable products, or expensive water-treatment plants, (which are also needed) the product being exported is education. Education is the foundation for any nation to grow and prosper. Education can give a generation a head-up and allow for future investment in one's own needs.

Foreigners have donated and helped build infrastructure; however, they failed to leave a sustainable solution to many of the problems. At first glance, you want to give the underprivileged food, shelter and water. As we are aware, clean water is a problem for many communities. Financed by international and private donors, water treatment plants have been built; however, it was found that within a year's time that the community was unable to keep it running because of the high cost or lack of supplies. (Prahalad, 2005) Foreign aid is needed, but makes the donor countries economically dependant upon others, especially when the solutions are not sustainable. Another criticism of foreign aid is that it is foreign. It does not appreciate the rich culture and usually fulfills its own narcissistic needs before its recipients. So how do you respect one's culture and help them to progress at the same time? Give them the gift of knowledge and communication.

It is important for the LAC to cultivate their industrial revolution to progress to economic stability; however, in today's world "industrial revolution" cannot repeat the sins of the past. The industrial revolution of Europe and the United States wreaked havoc on the environment and people's health. Developing countries have to be smarter.

Definition of Terms

Bottom of the Pyramid Bottom of the Pyramid (also known as 'Base of the Pyramid' or BOP) refers to sustainable business models that target the over 4 billion people who live on less than US \$2,000 per year. Professor C.K. Prahalad of the University of Michigan and Dr. Stuart Hart of Cornell University coined this phrase in their 2002 article, 'The Fortune at the Bottom of the Pyramid,' published by the business journal *strategy + business*

Consumables are goods that have to be bought regularly because they wear out or are used up, such as food and clothing. Products that are intended to be discarded rather than saved.

Developing Country refers to low- and middle-income countries in which most people have a lower standard of living with access to fewer goods and services than do most people in high-income countries. There are currently about 125 developing countries with populations over 1 million; in 1998, their total population was more than 5.0 billion.

Ergonomics is the study of human characteristics for the appropriate design of the living and working environment. Ergonomic researchers strive to learn about human characteristics (capabilities, limitations, motivations, and desires) so that this knowledge can be used to adapt a human-made environment to the people involved. This knowledge may affect complex technical systems or work tasks, equipment, and workstations, or the

tools and utensils used at work, at home, or during leisure times. Hence, ergonomics is human-centered, trans-disciplinary, and application-oriented. The goals of ergonomics range from the basic aim of making work safe through increasing human efficiency to the purpose of creating human well-being.

Industrial design is the professional service of creating and developing concepts and specifications that optimize the function, value, and appearance of products and systems for the mutual benefit of both user and manufacturer [Industrial Design Society of America].

Infrastructure or **political infrastructure** consists of state institutions, departments, or other products of political organization. The national political infrastructure of a country helps to define its investment environment and thus favorable conditions for economic growth.

Political economy is an early name for the discipline of economics. It is a field within economics encompassing several alternatives to neoclassical economics, including Marxist economics. It is also called radical political economy that is a field within economics that concerns the interactions between political processes and economic variables, especially economic policies.

Semiotics is the study of the sign-systems by which meaningful communication or literary discourse occurs. The operations by which a reader/receiver interprets signs and makes them meaningful is termed naturalization. 'Signs' may be anything from which meanings may be generated (such as words, images, sounds, gestures and objects). For the analytical purposes of semiotics every sign is composed of: a 'signifier' - the form which the sign takes; and the 'signified' - the concept it represents. Nowadays, the 'signifier' is commonly interpreted as the material form of the sign.

Sustainable refers to economic development and is sought by societies not only to satisfy basic material needs, but also to provide the resources to improve the quality of life in other directions, meeting the demand for health care, education and a good environment. Many forms of economic development make demands upon the environment; they use natural resources that are sometimes in limited supply, and generate by-products of pollution and waste. Economic activity can protect or enhance the environment by including energy efficiency measures, improved technology and techniques of management, better product design and marketing, waste minimization, environmentally friendly farming practices, making better use of land and buildings, and improved transport efficiency. The challenge of sustainable development is to promote ways of encouraging this kind of environmentally friendly economic activity, and of discouraging environmentally damaging activities.

Third world refers to the poorest nations of the world. Most Third World nations are in debt to Western banks and governments or international lending organizations. Many depend on international aid to meet the basic needs of their population. (See Developing Countries.) This term has fallen into disfavor in recent years, replaced by terms such as Less-Developed Country (LDC), developing nations, and the Global South.

User-centered Design (UCD) is an approach to designing the ease of use into the total customer experience with products and systems. It involves two fundamental elements: multidisciplinary teamwork and a set of specialized methods of acquiring user input and converting it into design.' There are many benefits. The short story is that it results in better products, happier customers and more profit. The risks are primarily organizational. UCD must be introduced and implemented in a manner that is appropriate for a given organization. It addresses the total user experience, which is broader than usability. UCD is a multidisciplinary approach. Consider the user experience a coming together of technology: the user's interaction with the offering's user interface, the marketing materials, the ordering process, the aesthetics, etc.

World Trade Organization (WTO) is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments. The goal is to help producers of goods and services, exporters, and importers conduct their business.

CHAPTER TWO
FACTORS FOR THE DEVELOPMENT OF AN EDUCATIONAL PRODUCT FOR
LATIN AMERICA

Four billion poor live on less than two dollars a day. The poor as a market are 5 billion strong providing an opportunity for growth and innovation. However, we cannot produce as we have in the past by wasting our resources. We must concern ourselves with the future of our children by solving problems in a sustainable and ecologically friendly way. As a means for growth for stagnant markets, large firms can profit by the inspiration of the sheer multitude of the poor. However, capitalists be forewarned that the poor as a market are not to be assumed as ignorant. They work hard for their money and want the quality that they pay for. We assume that the poor do not make a viable opportunity to sell products. Of course, the purchasing power of people who make less than two dollars a day cannot be compared to the rich or even middle class, but their sheer numbers make them viable as a market; however, they need a different approach (Prahalad, 2005).

Ideally, we wish the poor to have quality of life. Maslow's Hierarchy of Needs is depicted on <http://www.pateo.com/images/maslowmaster4ts.gif>. Maslow theorized that the human requires his physiological needs, including water, food, sleep, warmth, health, exercise and sex to be met. Once these needs are met, one's security needs, including physical protection from danger, economic security, comfort and peace can be met. Only then, one's social needs, such as belonging, and association with a successful team and

the love and affection that go along with being part of a group can the need for self-esteem be attained. At this tier of Maslow's Hierarchy of Needs, one can undertake important projects and recognize his own strength and intelligence, prestige and status. Finally, one can reach self-actualization, which includes challenging projects that allow for innovation and creativity.

Designing for emerging markets should include the psychology of Maslow's theory as well as the physical needs which Lidwell, Holden and Butler relate to their hierarchy of needs when applying Maslow's basic tenets to products. They advocate that good design follows five key levels, functionality, reliability, usability, proficiency and creativity. Design must serve low-level needs of functionality before they can build on higher levels such as creativity. They hypothesize that the functionality of a product must meet the basic design needs, although designs at this level are perceived as having little or no value. Reliability builds on functionality by establishing stable and consistent performance, adding some value to a product. The usability allows the user ease of use. It cannot be difficult to use, nor the consequences of errors cannot be too great. Proficiency empowers the user to do things easier than they could previously and adds more value to the product. Finally, creativity is the highest level encompassing all needs. A design having all these needs can be used to create ideas and extend beyond what the product or the user alone could do (Lidwell et al., 2003).

Prahalad advocates that when designing for the BOP, it is even more important that the designer has a deep understanding of functionality, before form. This is not a call for more functions, such as the cell phone, with video, mp3, Bluetooth technology, etc. It is an in-depth understanding of what the function needed for duty it is designed for or the

culture. It is crucial that the old paradigms of product development are thought of in new and customized ways, including the services and distribution of them (Prahalad, 2005).

We assume that the poor are not brand-conscious; however, they are more so out of necessity. Ironically, the poor spend their earnings with a different set of priorities. There is a tendency to spend any disposable income on luxuries rather than improving their homes or clean running water. The reason for this is that without a legal title to one's own land, they are unwilling to invest in it. For example, In Dharavi, India, Asia's largest slum in the middle of India's financial capital, Mumbai, 85% of the households own a television, and 56% own a gas stove. Casa Bahia of Brazil and Elecktra in Mexico are two of the largest retailers of consumer durables, like televisions, washing machines and other appliances. This suggests that they are very brand conscious. The levels of functionality and reliability that Lidwell et al. speak of are of great value to the market at the Bottom of the Pyramid. They expect quality at prices they can afford (Prahalad, 2005).

In order to accomplish these basic needs in an economically centered world, it is realistic that the poor need to have the capability to earn. To make this possible, Prahalad states three principles in which a different approach can be made. The first is affordability. It is important that products are affordable without losing quality. The second is access, assuring that this new customer base has products available. For example, after five o'clock when most workers get off work, products need to be accessible, within walking distance of their work or home. Finally, availability, products need to be in-stock when the consumer has the cash. The developed economies are dependant upon creating large unit packs and selling them with a high margin of profit;

however, for developing markets this model must be different. The BOP market calls for smaller packages sold at affordable prices with a smaller profit per unit, but yielding profit by the selling of high volume. In India, Procter and Gamble sells its popular Pantene shampoo in sachet packs, rather than economy size bottles and ends up selling as much of their product as in the US. For this reason, innovations made for the BOP need to be scalable. They must be able to transport to other countries, cultures and languages with similar markets by making simple modifications. This is important for the case of making a profit by selling in bulk (Prahalad, 2005).

By 2015, there will be more than 225 cities in Africa, 903 in Asia and 225 in Latin America. Each one of these cities will have more than one million people and at least 23 of these cities will have a population over 10 million totaling 1.5 to 2.0 billion people. Thirty-five to 40 percent will be the world's poorest. In other words, there will be 15,000 people per hectare (2.71 acres). In the rural areas, distribution remains problematic because they are in what is called, "media dark" or inaccessible to audio and television. Because of this, the rural poor are literally left in the dark to what products and services are available and how to use them. (Prahalad, 2005)

The following table depicts the past and present statistical data on poverty for Latin America and some Caribbean countries that are not significantly influenced by tourism. It was compiled with the most current data from the CIA World Factbook from <https://www.cia.gov/cia/publications/factbook/index.html>. The table shows the population, the Gross National Product per capita and the percentage of the population who live in poverty. Notably, the United States yields a 12% poverty rate and a \$41,000

GDP per capita versus the rest of the world with a 30% poverty rate and \$9,500 GDP per capita.

	Countries	Population	GDP per capita	Poverty
Latin American Countries	Argentina	39,921,833 (July 2006 est.)	\$13,100 (2005 est.)	38.5% (June 2005)
	Belize	287,730 (July 2006 est.)	\$6,800 (2005 est.)	33% (1999 est.)
	Bolivia	8,989,046 (July 2006 est.)	\$2,900 (2005 est.)	64% (2004 est.)
	Brazil	188,078,227	\$8,400 (2005 est.)	22% (1998 est.)
	Chile	16,134,219 (July 2006 est.)	\$11,300 (2005 est.)	18.2% (2005)
	Columbia	43,593,035 (July 2006 est.)	\$7,900 (2005 est.)	49.2% (2005)
	Costa Rica	4,075,261 (July 2006 est.)	\$11,100 (2005 est.)	18% (2004 est.)
	Ecuador	13,547,510 (July 2006 est.)	\$4,300 (2005 est.)	41% (2006)
	El Salvador	6,822,378 (July 2006 est.)	\$4,700 (2005 est.)	36.1% (2004 est.)
	Guatemala	12,293,545 (July 2006 est.)	\$4,700 (2005 est.)	75% (2004 est.)
	Guyana	767,245	\$4,600 (2005 est.)	NA%
	Honduras	7,326,496	\$2,900 (2005 est.)	53% (1993 est.)
	Mexico	107,449,525 (July 2006 est.)	\$10,000 (2005 est.)	40% (2003 est.)
	Nicaragua	5,570,129 (July 2006 est.)	\$2,900 (2005 est.)	50% (2001 est.)
	Trinidad & Tobago	1,065,842 (July 2006 est.)	\$16,700 (2005 est.)	21% (1992 est.)
	Venezuela	25,730,435 (July 2006 est.)	\$6,100 (2005 est.)	47% (1998 est.)
	Paraguay	6,506,464 (July 2006 est.)	\$4,900 (2005 est.)	32% (2005 est.)
	Panama	3,191,319 (July 2006 est.)	\$7,200 (2005 est.)	9.8% (2005 est.)
	Uruguay	3,431,932 (July 2006 est.)	\$9,600 (2005 est.)	22% (2004)
	Venezuela	25,730,435 (July 2006 est.)	\$6,100 (2005 est.)	47% (1998 est.)
Caribbean Islands	The Bahamas	303,770	\$20,200 (2005 est.)	9.3% (2004)
	Dominican Republic	9,183,984 (July 2006 est.)	\$7,000 (2005 est.)	25%
	Haiti	8,308,504	\$1,700 (2005 est.)	80% (2003 est.)
	Jamaica	2,758,124 (July 2006 est.)	\$4,400 (2005 est.)	19.1% (2003 est.)
	United States	298,444,215 (July 2006 est.)	\$41,800 (2005 est.)	12% (2004 est.)
	World	6,525,170,264 (July 2006 est.)	\$9,500 (2005 est.)	30%

Table 1. Poverty in Latin America and the sample of the Caribbean

Leapfrogging Technology

In 1995, Nelson Mandela, at the Telecom 95 Conference said,

the information revolution should be geared towards enhancing global citizenship and global economic prosperity...a diversity of paths towards the achievements of national information societies should be respected...the evolution of policy for the development of an equitable

global information society should be co-coordinated internationally to ensure the sharing of information and resources. [Davison, p. 6]

“Leapfrogging is the notion that areas which have poorly developed technology or economic bases can move themselves forward rapidly through the adoption of modern systems without going through intermediary steps” (Cascio, 2004). It is, “the specific use of IT to accelerate development and promote economic growth” (Davison, 2000). The assumptions are that it is a technical shortcut irreverent of the values of any social context. It is also assumed that there is only path for development and that is following developed countries, which would keep developing countries in a subordinate position and finally, it is assumed that leapfrogging is a luxury. However, it is apparent that developing countries, without the implementation of information technology (IT), take the chance of becoming further marginalized and left out of the global economic world. It is not a panacea within itself. It requires more than ad hoc implementation. It is how people communicate and how they do business. The adaptation of information technologies where communication is still not available to everyone is the beginning to an immense change to cultures around the world and needs the understanding of those whom it will affect. (Davison, 2000)

Leapfrogging can be examined in three contexts, social, economic and political. It requires the involvement of those who will benefit, such as the individuals, groups and institutions in the context of an effective political environment while having the commitment of financial support. It entails the synergy of technology in a social context to generate this new culture. Economically, we are warned of the irresponsibility of

making expensive decisions that only work vertically in a single local context and do not expand to the rest of the world. It does not assure the prosperity of developing nations, but it is linked to economic prosperity. The dependence on governmental foreign aid and development banks is not advised. It is preferred that financing be shifted toward the private sector for the reasons of investment, the amount of capital that will be required for growth and for the benefits of foreign investment for political stability. In a study of Latin America and the Caribbean (LAC) telephone and cell phone adoptions have been shown to prosper with good economic conditions and privatization. Cell phone use in the LAC grew from 100,000 to 39 million in the 1990s alone. Wireless communications have exceeded landline use. Chile, El Salvador, Mexico, Paraguay and Venezuela have more cell phone users than all of Latin America. Because of privatization in the late 1980s and lessening of telecommunications barriers in policy, deregulation has driven the price of services down.

Countries	Telephones	Cell-phones	Internet
Argentina	8.8 million (2005)	13,512,400 (2004)	10 million (2005)
Belize	33,300 (2005)	91,700 (2004)	35,000 (2005)
Bolivia	646,300 (2005)	1,800,800 (2004)	350,000 (2005)
Brazil	42,382,200 (2004)	65.605 million (2004)	25.9 million (2005)
Chile	3,435,900 (2005)	9,566,600 (2004)	5.6 million (2004)
Colombia	7,678,800 (2005)	10,400,600 (2004)	3,585,688 (2004)
Costa Rica	1,388,500 (2005)	923,100 (2004)	1 million (2005)
Ecuador	1,701,500 (2005)	3,544,200 (2004)	624,600 (2005)
El Salvador	971,500 (2005)	1,832,600 (2004)	587,500 (2005)
Guatemala	1,132,100 (2004)	3,168,300 (2004)	756,000 (2005)
Guyana	110,100 (2005)	104,600 (2004)	145,000 (2005)
Honduras	494,400 (2005)	707,200 (2004)	223,000 (2005)
Mexico	19.512 million (2005)	38,451,100 (2004)	16,995,400 (2005)
Panama	440,100 (2005)	855,900 (2004)	300,000 (2005)
Paraguay	320,300 (2005)	320,300 (2005)	1,770,300 (2003)
Trinidad & Tobago	323,500 (2005)	651,200 (2004)	160,000 (2005)
Nicaragua	220,900 (2005)	738,600 (2004)	125,000 (2005)
Uruguay	1 million (2004)	652,000 (2002)	680,000 (2005)
Venezuela	3,605,500 (2005)	8.421 million (2004)	3.04 million (2005)
The Bahamas	139,900 (2004)	186,000 (2004)	93,000 (2005)
Dominican Republic	894,500 (2005)	2,534,100 (2004)	800,000 (2005)
Haiti	140,000 (2004)	400,000 (2004)	500,000 (2005)
Jamaica	342,000 (2005)	2.2 million (2004)	1.067 million (2005)
United States	268 million (2003)	194,479,364 (2005)	203,824,428 (2005)
World	1,206,315,500 (2004)	1,752,183,600 (2004)	1,018,057,389 (2005)

Table 2. Telecommunications in Latin America and the Caribbean

Using GDP per capita as a measure of economic growth, we find most Latin American countries to be in the middle-income range; however, countries such as Haiti, Honduras and Nicaragua remain in the low-income bracket, defined as less than or equal to US\$760. The middle income is defined as more than US\$ 760 and less or equal to US\$9360. Cell phone growth began slower than other middle-income countries but has since has gone beyond them. One of the reasons for this is that it is viewed as a substitute technology. The demand for landlines has surpassed the supply; therefore, there is a low adoption rate for telephones. The second reason is that the privatization of telecommunications in Latin America has created competition that has driven down the prices. The growth of cell phone use has been extraordinarily fast. For 25% of the

population to adopt telephones it took 35 years versus only 13 years for cell phones. By 2010, the telephone will have more than doubled to reach 49% of the population while mobile phone use will have tripled to 60%. (Bagchi et al., 2005)

In a political context, the government can limit the adoption of technology by establishing protective legislation. (Bagchi et al., 2003) They must understand that they may not have control over how technology grows; however, they have the responsibility to write policies that have vision and long-term commitment. They have the responsibility of making policies that mutually benefit the social context and the financial context by retaining control of policy and facilities where foreign investment is concerned. (Davison, 2000)

With a worldwide population of 103 million Mexicans, in Mexico there are 50 million Mexicans living in poverty. Internet access could be a determining factor in the success of development. Through access to the World Wide Web, it is possible to empower rural people throughout the world. Rural areas have never had the infrastructure for communications, but it is possible to leapfrog older technologies and create Internet capabilities and cell phone usage for those who never had a telephone in their home. By allowing this access to the internet it would allow for those living in rural poverty to find information for such things as crop prices, micro financing, distribution, health information and an efficient and less costly way of remitting payments. Ironically, here in the United States the most inexpensive connection to the Internet is dial-up, costing about \$10 per month, which is still too expensive for a BOP family, yet it is not even possible because there is no telephone line to connect. As a result, innovators must think beyond what is least expensive as a solution.

This can be possible by access to ‘free spectrum,’ one of the bands that can be used by the public without any license, permit or filing requirements, making broadband access affordable. However, for example, in Mexico, the law prohibits use of free spectrum. (Labardini, 2004)

The merging of rural connectivity with grassroots development allows for strengthening local economies by communication of production and distribution; improvements on education, and health services. (Labardini, 2004) An example of this was in India. An Indian conglomerate called ITC connected farmers in their villages by creating a kiosk of computers with internet connections at a very low hourly rate so they could check prices at local auction houses as well as soybean futures on the Chicago Board of Trade which allowed them to make decisions about selling their own crops. (Pralhad, 2005)

The ‘bottom of the pyramid’ consumers are already showing great numbers in getting connected. There is widespread evidence that they are rapidly exploiting the benefits of wireless mobile phones. By the end of 2003, China had 250 million cell phones, India was growing at 1.5 million handsets per month and Brazil had 35 to 40 million. The acceptance of technology was easy because there were no old technologies to compare them to. (Pralhad, 2005)

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Dominican Republic	894,500 (2005)	2,534,100 (2004)	800,000 (2005)
Haiti	140,000 (2004)	400,000 (2004)	500,000 (2005)
Jamaica	342,000 (2005)	2.2 million (2004)	1.067 million (2005)
United States	268 million (2003)	194,479,364 (2005)	203,824,428 (2005)
World	1,206,315,500 (2004)	1,752,183,600 (2004)	1,018,057,389 (2005)

Table 3. Telecommunication Comparisons between the LAC and the United States

In Bolivia, PRODEM FFP, a financial services company introduced Automated Teller Machines (ATMs) that circumvent some of the problematic issues such as illiteracy and multiple languages being spoken in the same area. This ATM is equipped with fingerprint recognition and a color-coded touch screen so that their customers have access to financial services twenty-four hours a day. (Pralhad, 2005)

One of the problems of underdeveloped countries is the hostile environment in which technology must survive. Infrastructure can limit the types of technology available. Why can we not just give charitable dollars to developing countries so that they can have computers, set up free spectrum broadband internet and solve communication problems? Billions have already been investing in water treatment plants only to find that a year

later, they were unable to keep them working because they either did not have the electricity to run them or could not afford to run these facilities. They also did not receive enough chemicals or spare parts to run such an operation. In places without dependable electricity, and with high illiteracy rates, the solution to the problem takes a different and all encompassing approach. Therefore, hybrid solutions must be made, where innovation is blended with existing infrastructures. (Prahalad, 2005)

Political and Economic

Poverty is caused by a wealth of problems. On the macro level, there are political instability, natural disasters, corruption, socio-economic disparities and prejudice, and a lack of access to education and infrastructure. For clarification, on a global scope the “poorest” or “very poor” are referred to as those living on less than one dollar a day or the bottom half of what their respected country designates as the poverty line. The “poor” refers to those who live above one dollar per day or those who live on the top half of those below the poverty line. The effects of poverty at the micro level are poor nutrition and healthcare causing children to be at risk of disease. The destitution of families makes it impossible to invest in such assets as livestock or housing. Most poor are “self-employed” where all of their money is spent towards survival. If these challenges are not enough, the lack of education confines the youth to the same lives of their parents. (Poverty: A Global Problem, 2006) The result of education has led to increased farmer productivity, reduction in fertility, improved health and nutrition, encouraged more “modern” attitudes, such as empirical and egalitarian beliefs. All these are recognized as necessary for a nation to prosper politically and economically. By improving the

efficiency of education through dropout and repetition reduction, there are economic savings (Wolff et al. 1994)

Early childhood development is linked to increased productivity of participating children for later productivity. Educational attainment and occupational placement and experience will result in adult productivity. Schooling affects a greater understanding of technology. (Wolff et al. 1994)

Cultural Considerations

Economic development has long been the basis on which aid has been given to developing countries for education. There are consequences to looking at education as having purely economic outcomes. It is important to involve social and cultural aspects to education. (Little, 1999) Latin Americans see the importance of education in a broader sense involving qualitatively different relations with the environment. This is evident in the southeastern Peruvian Amazon where education policy promotes an exchange between different cultures in the region involving human resource development and respect for the environment. In Cuzco, Peru, September 1991, a policy was approved for the Madre de Dios, an area of tropical rainforest within the otherwise Andean Inca region. This new policy addressed objectives to enhance the potential of youth, creating sustainable economic and ecological practices, and promoting more equitable relationships among the various linguistic and cultural groups. This new policy was in response to the exploitative nature of development in the area as well as a new global consideration of new educational policies shown in Mexico, Bolivia, Chile and the Dominican Republic, Ecuador, and Peru in cooperation with NGOs, social institutions

and religious orders. In Madre de Dios, there are some 10,000 indigenous people belonging to seven different linguistic families and 19 different ethno linguistic groups. There was an expansion of primary schooling in the 1980s because of increasing demand in the rural areas; however, most secondary education can be found in urban areas. Teachers in this area have a high turnover rate and those with the least experience are sent to work in multi-grade classrooms or single-teacher schools. They must follow the national curriculum using textbooks that are standardized for urban education. Within the region there is a social hierarchy of Mestizos, Serranos and the indigenous Amazonians. The same hierarchy exists in the school system. Mestizos come from a mixed racial descent. They are settlers from impoverished coastal towns that have become urban. Their education reflects the middle-class, urban Mestizo education provided in Lima. They see themselves as pioneering a better future for themselves and their children by bringing development to the rainforest. Though their form of development consists of the mining and trade of the rainforest, they support economic policies that will create communication and sees schooling as an investment in the future. Mestizo parents supplement teacher salaries with room and board to encourage them to stay. (Aikman, 1999)

Serranos come from no education and small isolated highland communities. They are bound together by ties to the environment and isolated along the riverbanks. They exploit the rainforest to grow maize. Indigenous to the rainforest, they are defined by their relationship to the land, something that has to be conquered and tamed. Schooling is not a reflection of their Quechua values or useful to their way of life. (Aikman, 1999)

The indigenous, Amazonians or Arakmbuts, do not focus on development or economic growth. Their world consists of their social and spiritual values and the progression of gardening, hunting and fishing. They wish to participate in formal education because of the social status that it will give them in the eyes of the Serrano, Mestizo and missionaries, help combat change imposed by the outside world and given “official” recognition as a native community by the state. (Aikman, 1999)

The new education policy promotes skills needed for occupations needed in the region and promotes communal dialogue, planning and decision making among the different groups of Madre de Dios. Therefore, their education policy has taken aim to work with their natural environment, and how education should take shape in their vision for the future. Schools teach Spanish which they need in order to help with these issues. However, they want education to respect their own values. (Aikman, 1999)

If the goal of development is to raise the standard of living of people, it is important for outsiders to work within the value system of those being developed. Fasheh (1999) criticizes The World Bank for their use of development as a business that has survived throughout the past 50 years by changing from social progress with economic growth to rural development, from unemployment and inequality, to eradication of poverty, from fighting ignorance and hunger to meeting basic needs, from environmental and ecological concerns to advancement of women and human rights to civil society and democracy to institutional development to social development and finally, development for peace. Fasheh (1999) contends that development is a subtle form of control by determining priorities, choosing and defining terms, stressing certain problems, imposing solution and deciding who implements them. He insists that development is not based on

per capita income versus the family who can live happily and produce all it needs.

Development should not be gauged by whether or not everyone has a Coca Cola. The most important subtle control for this paper's purposes is that schools have limited the imagination and sense of possibilities in the field of education and learning by not using resources to experiment with innovative ideas, building communication networks among people, or establishing facilities that increase people's access to relevant information. A people that does not produce culturally and intellectually ends up being dependent, wasteful, disintegrated, and unable to deal with its needs and challenges. (Fasheh, 1999)

As we have learned through history, there are consequences of development. Termed "colonialism" in the Pacific Islands, the French, English, and Americans used education as a tool to "westernize" or develop the indigenous peoples of the Pacific Islands. In the process, the ideologies of developed cultures were introduced to Pacific societies through overt and hidden curriculum. They were taught to reject many of their own cultural values in order to "educate" and "civilize." Missionaries taught formal education that was concerned primarily with educating the youth with an urban or industrial education, which will increase their chances for a career in the cash economy, causing a brain drain. Their education has not prepared them for the cultural and economic realities of their homes to work locally so they must leave. Informal education prepared them for their societal roles and limited their knowledge to what was appropriate to their social position and environment and necessary for survival and cultural continuation (Helu-Thaman, 1999). Little (1999) asserts that the mechanisms of success and failure in education systems, and especially the processes of selection and

certification, ensure that those with the greatest cultural capital succeed, while simultaneously preserving the ideals of equality and meritocracy (Little, 1999).

Based on a study by Barros and Lam (1996) that found a correlation between income and education, Nunes and Roazzi (1999) found that in urban Brazil children coming from lower and higher socioeconomic backgrounds live in two different worlds that give middle class children reasons for learning and lower class children reasons for not learning. Children from working class families only had a use for “practical” education, had no plans of remaining in school after they had learned the basics of reading, writing and arithmetic and wished only to achieve a level of education that would get them the job that they desired. Although both groups share the idea that education will lead to better economic status, the cognitive analysis of lower socioeconomic children understand economic stratification at a different level. Whereas the children understand that with more education they can become a doctor or a lawyer and obtain all the economic and social perks that come with a profession, for a child whose father or mother works as a laborer the aspirations of becoming a grocery clerk is understood as moving up in status. Children from working class families see occupations that are clean, in the shade and sitting down and have no pressure to improve performance as a worthy goal. For those who wish to remain in school “theoretical” concepts were more easily accepted (Nunes & Roazzi, 1999). Perhaps it is a matter of the here and now. Where children are needed to work and provide for their families, education is not a priority and many of these children either have inconsistent attendance or drop out all together. How can you “waste” time learning algebra when you do not know where your next meal will come from?

Funding

One of the difficulties in donor-financed projects is that they reflect the donor's values (Little, 1999). Economic development, social and health education and missions are all valiant ideals; however, the culture of a society cannot be nullified in the process of aiding education in developing countries. Money and materials for education are limited and donors must be efficient, equitable and effective with their resources. Schools are expected to contribute to the development of the individual, the social and cultural progress and the economic growth of a nation.

Latin America and the Caribbean (LAC) appreciate the importance of primary education. One indicator is the growth in international lending. The World Bank shows an increase from US\$20 million per year (1985-90) to US\$500 million (1991-95). The World Bank recommends an increase in spending on primary education by at least 15%. Research supports the importance of primary education in economic development; they have found that there is a high correlation between national investment in education and economic growth. There can also be high social returns with the support of primary education. This is apparent in the growing interest in international lending towards primary school education. The World Bank's lending for Latin America and the Caribbean has increased from an average of US\$ 20 million per year in 1985-90 to US \$500 million in 1991-95. Because of the economic downturn in the 1980s, Latin America governments were unable to spend on primary education. Latin America and the Caribbean (LAC) is also subject to criticism on the lack of human resources and policy efforts (Wolff et. al., 1994).

Government

Regional interest in primary school education is notable by the interest to which Ministers of Education have committed themselves. Public expenditure on primary school education increased in the 1970s; however, it waned in the 1980s because of economic turmoil. The public sector, albeit financing, publishing, printing, distributing, regulating, plays a part in the provision of textbooks to students. The private sector contributes in various ways (Wolff et al., 1994).

Governmental (International) Agencies

The regional office of UNESCO has taken an interest in the improvement in primary education. For international development agencies, the focus is on national and intra national concern for the global environment and global communication systems and their implication on global economies and national education systems (Little, 1999).

It is not only the government's responsibility to fund primary school education; however, it is important that the priorities set have a committed income. The student's families to encourage a sense of ownership and investment in their child's education should augment funding; however, textbooks and supplies should take priority over uniforms. "Governments can also engage the help of international development agencies such as, the World Bank, USAID and the IDB for short-term financing, on the grounds that educational materials have been shown to be a profitable investment in internal efficiency, as well as a cost-effective means of improving primary education overall." External donors should be responsible for recurrent expenses (Wolff et. al., 1994).

Microfinance

Because the bottom of the pyramid is cash poor, availability to goods has to be innovative and patient. Brazil's Casa Bahia makes it possible for consumers to buy large ticket, name-brand items, such as washing machines and televisions by extending a line of credit, but not in a traditional sense. For the bottom of the pyramid customer, payments may be unpredictable and incomes are low. Casa Bahia has developed a sophisticated credit rating system along with a counseling program. They ensure that its consumers are not overextended and their patience has paid off. The default rate is a low 8.5%, compared to over 15% for some of their competitors. (Prahalad, 2005)

Cemex is the second largest cement company in Mexico. In the 1990's they suffered from the devaluation of the Mexican peso that eliminated more than a million jobs in Mexico. Cemex began to look at the millions of poor Mexicans who spend years to build their own homes because of erratic cash flow. They studied the "*auto-construccion*" or do-it-yourself practices that rural Mexicans use and created a model for reaching consumers in poor rural neighborhoods. Their program called *Patrimonio Hoy* or *Personal Property Today* "combines aspects of microlending and community money-pooling—to help low-income Mexicans build homes faster and better" (Sandoval, 2005).

Ecologic Finance has been a microfinance organization since 1999 and boasts \$35 million worth of loans to eleven Latin American and four African countries. Their mission is to help finance entrepreneurial endeavors at the grassroots level, while encouraging fair trade and conserving local habitats. They provide capital, social services and access to external markets. (Overview, 2004)

The Funding of Primary Education

Currently, Latin America spends approximately 1.1% of its GNP on primary education versus what are termed, Newly Industrializing Countries (NICs) in Asia who spend 1.5%. Industrialized countries spend 1.8% of GNP on primary education and much more on education in general. The financing of primary education should have a protected and prioritized place in public financing. The financing of textbooks and teaching materials rely on the government's commitment investment and financing. Textbook financing will cause the current expense of US \$2 per student on educational materials to rise to US \$5 per student. (Wolff et. al., 1994)

Parents

World Bank suggests that parents should contribute to the cost of educational materials as an investment in their children's education as well as helping local school funding. (Wolff et. al., 1994) Studies in Uganda and Cameroon show that introducing school fees on parents can keep some children from going to school. (Little, 1999) In Bolivia, Ecuador, Peru and Venezuela, parents pay for 85% of the cost of textbooks. The pressures on parents, especially in poorer areas, are significant. Chile's government pays for 50% of the costs of textbooks, but Colombia only pays for 34%. (Wolff et. al., 1994)

CHAPTER THREE

EDUCATION AND DEVELOPMENT IN LATIN AMERICA

Addressing factors for the improved education of Latin American Students

It is the duty of education to mold children into literate and productive citizens. Empirical evidence shows the availability of textbooks and teaching materials as valuable inputs towards this goal. It is important to provide time and instruction to healthy and well-nourished children to have the optimal outcome in education. Research does not show any notable progress in smaller classroom sizes and just the opposite in some urban environments, where increased class size resulted in higher achievement. However, when teachers have the time to use audience-specific and differentiated teaching strategies, then smaller class sizes can make a difference. Full-time, co-ed students tend to reach higher standards than those who attend same sex schools or attend in shifts. If school days are divided by shifts, the morning shift benefits. Teacher experience and schooling are significantly useful in the success of the students. These qualities along with teacher subject knowledge, experience with material and high student expectation create better student results.

Presently, education is scrutinized as homogeneous, discontinuous and mechanistic. (Little, 1999) Teaching methods are passive, teachers ask questions; pupils listen and do exercises. There is a discrepancy between what is taught and what is learned. The interaction is not an exchange. Children rarely ask for clarification to

concepts. (Little, 1999) Each student must take an exam at the end of the year to be promoted to the next grade resulting in high repetition rates and dropouts. Students are graduating but not able to do any of the jobs available in the region. (Aikman, 1999)

Nine-year-old students in Venezuela scored the lowest of 27 countries. In reading comprehension, the average student could only respond correctly on short and simple passages where the answer was stated. In a study on Science and Mathematics achievement in 1992, thirteen year olds in Sao Paulo and Fortaleza, Brazil scored slightly higher than Mozambique. The top scoring 5% of Brazilian students were equal to an average score of Korean, Taiwanese, Swiss, former Soviet Union, Hungarian and French students. (Wolff et al., 1994)

In a study of thirteen year olds in five LAC countries that ranges from elite private to rural, it was found that public, urban and rural students perform worse than the average student in the US and Thailand. Rural schools are noticeably poorer in achievement. Non-elite private schools do only slightly better than public schools. The samples were not scientific, and need further investigation before making conclusions, but this study found that elite private schools achieve as well or better than national averages in the US and Thailand. These schools only account for 13% of enrollments. Cost Rican scores are notably higher due to better teaching in this country. (Wolff et al., 1994)

One of the reasons that Latin America and the Caribbean countries have been chosen for this research is that they do significantly worse than Asian countries; however, there is industry and various degrees of infrastructure that would allow for improvement education.

Systems Approach

The Director of Institute of Design, Patrick Whitey set forth, after being inspired by C. K. Prahalad's *The Fortune at the Bottom of the Pyramid*, to initiate a research project in the slums of India to find an economically sustainable solution. Initially, some type of housing was their primary concern. After examining the physical, cognitive, social and cultural aspects of three different slums in India, it became apparent that a locally sustainable solution was contingent upon so many primary problems, such as water quality and access, sanitation, finance, health care, employment and education that they must take a systematic approach to designing for the base of the pyramid. (Whitney, 2004)

Focus on Primary education vs. secondary

Primary education should be made the major priority for the next decade. There is research that shows a high correlation between national investment in education and economic growth. Primary education has the responsibility to prepare children as literate, numerate and armed with problem solving skills in order to graduate to secondary education. The solution presented in this paper is in direct reaction to the World Bank's assessment of the needs for improving education in Latin America and the Caribbean. First of all, primary education is the main concern and has been shown to be a "fundamental for longer term economic and social development." Although literacy rates in the Latin American nations have grown to the ninetieth percentile over the past decade, this can be a deceitful statistic that will be further discussed. Most newly developing countries, such as, Israel, Japan and the Republic of Korea had achieved universal

enrollment for primary school aged children by 1965. The result has been increased average years of schooling. The World Bank presents three key investments with the best potential returns in respect to learning and retention that this paper will examine. The World Bank recommends:

- (1) Changing teachers' classroom behavior, through encouraging audience and context specific instruction, multi-grade teaching, new strategies of teaching reading, bilingual education and flexible promotion policies;
- (2) The provision of adequate quantity and quality of textbooks and educational materials to children and
- (3) To better measure progress of LAC, countries also need to devise a better system of monitoring key quality indicators, define and monitor key quality indicators, define assessment systems, and through supporting relevant educational research.

Managing these three areas are fundamental to improving primary education quality, which is only the first step in economic development. Primary education in the LAC is found to be doing significantly worse than other developing countries and some developing countries in Asia. There is some evidence that English speaking countries in the Caribbean are a little better. Private schools in the LAC do result in better test results; however they represent only 13%. (Wolff et. al., 1994)

Non-governmental agencies

The World Bank calls for collaboration among Governments, Non-governmental agencies and communities. NGOs, sometimes have an easier time of trying to coordinate and support projects than governments because of the top-heavy bureaucracy that keep

them from being effective in reform projects. It is important for the communities themselves to participate for the same reason, that governments lack the flexibility at the local and state level on new programs. To improve education in Latin America it is important for many sectors of society to collaborate. (Wolff et al., 1994)

School Children at a Disadvantage

Ten to twenty percent of school children will have problems that make it difficult for them to learn. Learning disabilities such as dyslexia, attention deficit disorder, psychological problems and low native ability exacerbate the problems of learning in an already difficult environment. This may even be a larger problem in the LAC because of inadequate nutrition. There are additional problems associated with home, especially those from lower socioeconomic groups such as the urban slums and the isolated rural areas. These children do not have reading materials at home, often have illiterate parents, or speak indigenous languages, the parents work long hours and they enter school without previous education or social experience.

Language

Language also exists on three levels of development, personal learning and identity, national development and international development. (Little, 1999) Since the late 1980s, South American governments have understood and legislated the need for intercultural and bilingual education for indigenous people. (Aikman, 1999) One of the dilemmas of education is creating textbooks for students with indigenous languages. For resource and production reasons this becomes difficult. How can educators respect the

Countries	Languages spoken
Argentina	Spanish (official), English, Italian, German, French
Belize	English (official), Spanish, Mayan, Garifuna (Carib), Creole
Bolivia	Spanish (official), Quechua (official), Aymara (official)
Brazil	Portuguese (official), Spanish, English, French
Chile	Spanish
Columbia	Spanish
Costa Rica	Spanish (official), English
Ecuador	Spanish (official), Amerindian languages (especially Quechua)
El Salvador	Spanish, Nahuatl (among some Amerindians)
Guatemala	Spanish 60%, Amerindian languages 40% (23 officially recognized Amerindian languages, including Quiche, Cakchiquel, Kekchi, Mam, Garifuna, and Xinca)
Guyana	English, Amerindian dialects, Creole, Hindi, Urdu
Honduras	Spanish, Amerindian dialects
Mexico	Spanish, various Mayan, Nahuatl, and other regional indigenous languages
Nicaragua	Spanish 97.5% (official), Miskito 1.7%, other 0.8% (1995 census) note: English and indigenous languages on Atlantic coast
Paraguay	Spanish (official), Guarani (official)
Panama	Spanish (official), English 14%, note - many Panamanians bilingual
Trinidad & Tobago	English (official), Hindi, French, Spanish, Chinese
Uruguay	Spanish, Portuguese, or Brazilerio (Portuguese-Spanish mix on the Brazilian frontier)
Venezuela	Spanish (official), numerous indigenous dialects
The Bahamas	immigrants)
Dominican Republic	Spanish
Haiti	French (official), Creole (official)
Jamaica	English, patois English
El Salvador	Spanish, Nahuatl (among some Amerindians)

Table 4. Languages spoken in Latin America and selections of the Caribbean

language and culture of different students while creating a national identity and the practical logistics of teaching a classroom with more than one language? It is reasonable to agree that there is an unofficial language of Latin America, Spanish. Much like the teachers in the United States teach in English with a standard English textbook, while it is prevalent that English is not the primary language spoken at home and the parents may not even speak English. Should textbooks in schools have a standard language, especially where there are too many languages to teach all of them? Should it be the responsibility of the parents to pass on the legacy of indigenous language and culture? One argument for

children not to go to school is that it is not relevant for some children who live a tribal or agricultural life. The costs of customization in the early stages, as well as the organization and teacher training involved seems prohibitive. The benefits of making policy primarily based on culture would end up too costly to benefit all. (Little, 1999) However, in this electronic age, it is possible to customize education. Involving indigenous languages

would only need to be used as an introduction to the learning of an official language such as Spanish in Latin America.

Gender inequalities

When money and culture are in question, parents are more likely to invest in a son's education rather than a daughter's. This is because cultural and social norms do not consider the education of women and girls as important (Little, 1999). Messina, in a study for UNESCO, refers to gender as a rational category and the way equality refers to the principles of justice and liberty by looking at learning relations, institutional relations, pedagogical practice, management and curriculum. In Latin America gender differences have been reduced when looking at school attendance. Girls' participation has grown to meet similar proportions to boys and in some countries have surpassed the enrollment of boys. In Bolivia, there were 81% boys and 73% girls in 1990. Guatemala and Brazil also showed five fewer percentage points for girls than boys; however, in Colombia, Venezuela and Nicaragua, there were fewer boys than girls by four to five percent in 1995. There are socio-economic indicators which show that in Honduras, El Salvador and the Dominican Republic in 1997, there were more girls than boys in the 7 to 12 years of age group. This is a show of less education being available to the poorest sectors (Messina, 2001). In the poorest and least educated communities, parents will chose to give their sons an education before a daughter (Little, 1999).

Indigenous girls in counties such as Guatemala are the most affected by gender inequality in education. Guatemalan girls average 0.9 years of schooling while boys from the same region attain 1.8 years of schooling. In a group of women ages twenty to twenty-four, only 30% have had any schooling (Messina, 2001).

The main obstacle of this inequality is the “lack of adequate curriculum to the cultural reality,” in which they live as well as the problem of language (Messina, 2001). The differences are clear while looking at urban and rural settings and the differences in private and public settings. There is a lack of documentation in socio-economic, rural versus urban, and social discrimination to ethnic group and their effects on the issue of gender inequality in education (Messina, 2001).

Efforts have been made towards reforms in the curriculum by such programs as non-sexist language in textbooks, sexual education and teacher training on gender issues; however, these are not always implemented (Messina, 2001).

However, in Bolivia, Chile, Ecuador, Venezuela, Panama and Paraguay the statistics for repetition show a closing gap between boys and girls. Girls average about three percentage points better than boys (Messina, 2001).

Literacy

Culture becomes a barrier when there is a resistance to education. Once it was thought that an anthropologist could move into a group of people, record their feelings, identify their customs, ways of life, ideas and this would constitute their culture. However, in contemporary thought, culture is a “contested process” rather than an inventory of characteristics (Street, 1999). Street categorizes literacy in three ways. His research is set in Iran in the 1970s. The first type of literacy is called, “maktabs” and relates to the teaching of the Koran in Islamic schools. It is stereotypically characterized by rote memorization, but the gentlemen used their skills to make transactions on the street. Children who were being educated in the state schools obtain a literacy termed

“dabastan;” however, this type of literacy was not being acknowledged by these men and received no respect within the village. It was not practical to do the local work of buying and selling. The third is commercial literacy. These types of literacy are not recognized by UNESCO. It is a prejudice of the modern world that without a certain amount of schooling, in years, or standardized testing that people of developing worlds live in “darkness, with mindlessness, and a lack of cognitive skills.” Anderson and Bowman (1966) present a theory that a forty percent literacy level is needed to result in economic growth. There is a modern attitude that literacy will create flexibility, adaptability, empathy, and acceptance of change and adaptation of innovations. It is possible that literacy and new skills can open up the doors to innovation. In a cultural sense, literacy is a social practice, not a skill. (Street, 1999) “Modern pedagogical theory emphasizes that literacy is not the formal understanding of certain fixed conventions and code. Rather, literacy requires that children understand its social role—as learning and as problem solving” (Street, 1999). In 1985 children in LAC averaged 4.2 years of schooling. In 1990 the literacy rate was 84% versus the Asian Newly Industrialized Countries (NICs) that average 6.3 years of schooling and a literacy rate of 94 percent. Only about 66% of Latin American students complete primary education. (Wolff et al., 1994)

Fourth and seventh grade Chilean and Venezuelan students were tested. They were unable to explain the meaning of simple phrases or estimate the square meters of their classroom. For comparison, approximately, 18% of US elementary school children are held back one year through eighth grade. California retains one in ten students up to second grade. In 54 out of 63 studies, it was found that holding children back was

detrimental to their development. The Wall Street Journal reported on June 16, 1992 that the children that were held back were 18% poorer readers than those who were promoted.

Countries	population	school-aged males (ages 0-14)	school-aged females	literacy (15 yr olds)	male	female
Argentina	39,921,833 (July 2006 est.)	5153164	4921625	0.971	97.10%	97.1% (2003 est.)
Belize	287,730 (July 2006 est.)	57923	55678	0.941	94.10%	94.1% (2003 est.)
Bolivia	8,989,046 (July 2006 est.)	1603982	1542319	0.872	93.10%	81.6% (2003 est.)
Brazil	188078227	24687656	23742998	0.864	0.861	86.6% (2003 est.)
Chile	16,134,219 (July 2006 est.)	2,035,278	1,944,754	0.9620%	96.40%	96.1% (2003 est.)
Columbia	43,593,035 (July 2006 est.)	6,683,079	6,528,563	0.9250%	92.40%	92.6% (2003 est.)
Costa Rica	4,075,261 (July 2006 est.)	590,261	563,196	0.96%	95.90%	96.1% (2003 est.)
Ecuador	13,547,510 (July 2006 est.)	2,281,499	2,195,551	0.9250%	94%	91% (2003 est.)
El Salvador	6,822,378 (July 2006 est.)	1,265,080	1,212,216	0.8020%	82.80%	77.7% (2003 est.)
Guatemala	12,293,545 (July 2006 est.)	2,573,359	2,479,098	0.7060%	78%	63.3% (2003 est.)
Guyana	767,245	102,551	98,772	0.9880%	99.10%	98.5% (2003 est.)
Honduras	7,326,496	1,491,170	1,429,816	0.7620%	76.10%	76.3% (2003 est.)
Mexico	107,449,525 (July 2006 est.)	16,770,957	16,086,172	0.9220%	94%	90.5% (2003 est.)
Nicaragua	5,570,129 (July 2006 est.)	1,031,897	994,633	0.6750%	67.20%	67.8% (2003 est.)
Trinidad & Tobago	1,065,842 (July 2006 est.)	109,936	104,076	0.9860%	99.10%	98% (2003 est.)
Venezuela	25,730,435 (July 2006 est.)	3,860,116	3,620,440		93.80%	93.1% (2003 est.)
Paraguay	6,506,464 (July 2006 est.)	1,245,149	1,204,970	0.94%	94.90%	93% (2003 est.)
Panama	3,191,319 (July 2006 est.)	492,403	472,996	0.93%	93.20%	91.9% (2003 est.)
Uruguay	3,431,932 (July 2006 est.)	399,409	386,136	0.98%	97.60%	98.4% (2003 est.)
Venezuela	25,730,435 (July 2006 est.)	3,860,116	3,620,440		93.80%	93.1% (2003 est.)
The Bahamas	303,770	41,799	41,733	0.9560%	94.70%	96.5% (2003 est.)
Dominican Republic	9,183,984 (July 2006 est.)	1,531,145	1,464,076	0.8470%	84.60%	84.8% (2003 est.)
Haiti	8,308,504	1,770,523	1,749,853	0.5290%	54.80%	51.2% (2003 est.)
Jamaica	2,758,124 (July 2006 est.)	464,297	449,181	0.8790%	84.10%	91.6% (2003 est.)
El Salvador	6,822,378 (July 2006 est.)	1,265,080	1,212,216	0.8020%	82.80%	77.7% (2003 est.)
United States	298,444,215 (July 2006 est.)	31,095,847	29,715,872	0.99%	99%	99% (2003 est.)
World	6,525,170,264 (July 2006 est.)	919,219,446	870,242,271	0.82%	87%	77%

Table 5. Literacy rates by gender in Latin America and the Caribbean

Repetition and Achievement

Only 47% of Latin American students eventually complete the primary school curriculum. Universal enrollment is a growing achievement. Ninety percent enter the first grade, but four out of nine six and seven year olds entering the first grade fail. First grade repetition rates have decreased since 1985; however, estimates project that repetition

rates will be reduced to 10% in 30 years, which is too long. Latin America spends US \$2.5 billion a year to teach these 20 million repeaters. (Wolff et. al., 1994)

A special survey by UNESCO notes that repetition rates reported by official statistics are actually twice as high. Jamaica, Chile, Uruguay and Colombia have the best record of dealing with repetition, but increased learning is still an issue. Haiti, El Salvador, Honduras and Nicaragua are the poorest countries and have the most vulnerable primary school systems. Underreporting is caused by four problems:

- (1) Students leave school to harvest, or for illnesses. They return the next year to the same grade and are reported as dropouts
- (2) Teachers do not have time for paperwork and documentation is faulty.
- (3) Students may pass with a satisfactory grade, but the teacher feels that the student would benefit from repeating.
- (4) Behavior problems that force students out of one school are introduced to another as a new enrollee (Wolff et. al., 1994).

Twenty-nine percent of all primary students are repeating their grade each year. It costs Latin American countries US \$2.5 billion each year for repeating students. This is mainly the result of inadequate learning, and poor effort by teachers and administrations, although the reality is that a low-repetition rate does not indicate that learning is happening. First grade teachers follow a criterion of failing children who do not learn the basics. On the other hand they may be advanced when they can say the written word, but not necessarily understand its meaning. The average student in Latin America is in school for 6.7 years, but only passes 5.0 grades. Children, especially in rural areas do not all start at the same age causing age heterogeneity. Some two-thirds enter school later. This

coupled with the repetition of grades adversely affects classroom learning. The more years a student remains in school adds to the likelihood that he or she will drop out. The older they get, the more capable they are to work. Weighed against the low morale and lack of personal efficacy of continually repeating, usually the choice is to drop out and find work. (Wolff et. al., 1994)

Repetition affects the poor children the most. The lower the education and income of the parents, the higher the chances are that the student will have to repeat. The children from rural and non-Spanish speaking families with low-incomes are also at risk of repeating. In Chile, the province of Malleco, with the largest native population, has twice the rate of repetition as the nation. (Wolff et. al., 1994)

Standards are lower in rural areas than middle-class. For example, in lower-class Northeast Brazil students may achieve literacy after one year of schooling, but are not advanced for three years versus middle-class students in the South and Southwest achieve literacy after six months and stay in first-grade for one and a half years. Socio-economic status is obviously a boon for the advancement. A study by Harvison and Hanushek (1992) in rural Northeast Brazil shows that there is little correlation between learning and grade promotion. Conditions in rural Brazil include multi-grade classrooms, in which the children are unaware of what grade they are supposed to be in. When students are able to adequately perform requirements, teachers should be encouraged to promote students. This has shown to be successful in Chile, Jamaica and Uruguay, where repetition rates of first graders reduced to less than 10%. (Wolff et al., 1994)

Repetition rates have been reduced in Columbia at the Escuela Nueva by seven percent. Increased learning is an indirect indicator of higher standards expected of

students. The unpleasant reality is that promotion is not necessarily based on better instruction, rather an intellectual and social priority. In the elite private schools, they rely on their reputation to maintain a regional or national prestige. Repeaters would have a higher achievement level than those in a public school, but are held back according to higher standards which they wish to achieve to get accepted to the best secondary schools. This is common in elite private schools and shown in Venezuela's *Fé y Alegría*. In these cases, repeating students may come from higher socioeconomic levels than those that are promoted. (Wolff et al., 1994)

Allegedly, there is a quota of students that are failed. In the case of Honduras, 80% were promoted, while 20% were not. All had passing grades. Brazil's repetition rates have not changed notably since 1930. Automatic promotion laws were enacted in Venezuela, Chile, and Colombia. Principals reported no repetition; however, analysis of students' ages showed that repetition had not changed at all. Dropping out was encouraged before the final exam period, children were not allowed to return after the harvest season and parents were advised to keep their children in the same grade until they matured. Policies made in hopes to help the children progress through the school system, hurt them instead. In Jamaica, there is a policy to promote children according to their age. Achievement tests show that between 31% and 48% of these children are functionally illiterate. These inconsistencies can be solved by a modular lesson system that will be further discussed in Modular Lessons in the Product Chapter.

There are three clusters of countries with repetition trends. The first cluster includes; El Salvador, Honduras, Guatemala, Dominican Republic, Haiti, and Brazil. They have first grade repetition rates of 50% or more and graduation rates up to 60%.

This is like a result of economic and social dislocations. The second cluster includes; Bolivia, Ecuador Paraguay, Panama, Costa Rica, Argentina, Mexico and Venezuela, all having repetition rates of 20% to 40%. Colombia has reduced their rate of repetition from 53% to 31% form 1980 to 1989 because of compulsory promotion from grades one to two and the addition of a grade zero. Better training of teachers in developmental pedagogy and increased parental literacy may have caused this cluster's reductions. Graduation rates for this cluster are 60% to 80%, with one exception. The third cluster is Uruguay, Chile, and Jamaica, who repeat less than 15% of their first graders due to age-based promotion and a strong in-service training. They graduate more than 75%. Chile's comprehensive program of teacher training, educational materials and encouraging teachers to promote children without adversely affecting learning has lowered the repetition rate and improved the cost-effectiveness of its primary education system. (Wolff et. al., 1994)

Physical Infrastructure

Gross primary school enrollment in LAC is over 90 percent; however, countries like, Haiti, the Dominican Republic, El Salvador and Guatemala do not have enough physical places for schools. The LAC is reasonably successful in providing enough physical environments, i.e. schools, chairs and desks for their students. In some rural areas, however, this is not true. The sheer distance that children have to travel to continue education in remote rural areas is the reason that they do not continue their education. In some of these cases, good students are taught individually by teachers in their "incomplete" schools, but show officially as repeaters. This practice is not monitored and

adds to the statistics of repeaters. The further the distance that children have to travel to get to school is negatively affecting academic achievement. (Wolff et al., 1994)

Teachers

Teachers are most beneficial to their students when they have experience, subject knowledge, experience with the materials and expectations of their pupils. Teacher behavior is fundamental to the results of the classroom. However, their situation is not congruous to the successful learning of primary students. Primary school teachers are approximately 4.2% of the labor force. Out of that statistic, only 79% of these are formally qualified with a recognized teaching degree. The World Bank's research shows that in-service training is inadequate. They provide teachers with another degree and a pay raise; however, they do not teach new classroom strategies. Teacher training consists of lectures and memorizing theoretical steps and it is difficult to introduce anything new. Teachers need hands-on training that will teach new behaviors. Teachers need exposure to more personalized and flexible teaching methods. They need pre-service training, schooling, subject-matter knowledge, to work with fellow teachers for curriculum development, parental involvement and incentive to attend. Low morale in the classroom is observed in the inertia and boredom seen in the classroom. (Wolff et. al., 1994)

Unfortunately, students who choose to go into the teaching profession tend to perform lower in academics and come from lower socioeconomic backgrounds than others obtaining a higher degree. Furthermore, teachers entering primary education had lower scores than those wanting to teach at the secondary level. The definition of

‘qualified’ varies depending on which country is in question. Many of the unqualified teachers are teaching in the more remote rural areas. (Wolff et al., 1994)

Improvements have included smaller class sizes, going from 32:1 to 29:1 from the late 80s to the mid 90s, but these marginal reductions do not necessarily increase the rate of learning for the students. Teachers have received better compensation during this time. Bolivia has the lowest student teacher ratios and the highest dropout rates. Teacher salaries are always an issue, as underpaid for their services, they still account for 95% of the education budget in many of these countries. (Wolff et. al., 1994)

In many cases, the school day for students is less than three and a half hours in urban schools, although teachers take double and triple shifts. Teachers do not have enough time for instruction or training and spend too much time on administrative duties. Their curriculum suffers because of time constraints and duties do not give them the time to grade lessons such as essays; therefore, students average two essays a year. Teacher absenteeism is a huge problem and strikes can last beyond a month’s time. Teacher absenteeism results in poor academic achievement. Officially, there are 180 days in the school year; however, between strikes and holidays, the actual days in school average about 120.

The World Bank suggests five teaching strategies to be established in the LAC

- (1) Specific instruction based on the students, i.e., rural or urban
- (2) Self-learning modules or textbooks designed for multi-grade classrooms
- (3) New approaches to teaching reading skills
- (4) Flexible bilingual assistance for the 10% of students speaking indigenous languages and

(5) Flexible promotion of students by teachers (Wolff et. al., 1994)

Another issue involving teachers is their pay. Salary incentives do not seem to make a difference in the improved academic performance of children in the classroom, however, well-trained, experienced and knowledgeable teachers do. Therefore, salaries are important in the retaining of and recruiting of good teachers. Teachers in Latin America have a difficult job due to poverty and parents that are sometimes illiterate. The World Bank recommends that there should be supplementary teacher training including information systems, and support pilot programs. Financing for such things should be allocated to non-governmental agencies. However, governments should ensure that teacher salaries do not decrease. Along with these progresses, there should be movement towards lengthening the length of the school day.

Curriculum

In the developed world pedagogical research shows the complexity of the learning process. To effectively teach students, it is necessary to customize their curriculum based on class size, and its composition. In multi-grade classrooms where teachers must be more active and audience-specific, the results are better than traditional pedagogical techniques. Traditional pedagogical techniques, such as rote memorization, result in low cognitive achievement. Current practice includes expository lessons to the entire classroom by using the blackboard to present the lesson and the children copying it. All subjects are presented in the same manner. The lessons have a tendency to be poorly structured and sequenced. There is little feedback or exchange between the pupil and the teacher. Small group lessons, individual lessons and activities are rarely used. Modern

pedagogy supports students learning broad concepts that include problem solving skills, decision-making, essay composition, preparation of research reports or the construction of a product. Teachers do not need to use a single teaching strategy, they need to be aware that each situation has a specific nature of the teaching/learning process. Teachers need the training and tools to implement effective learning. (Wolff et. al., 1994)

Latin America would like to ensure a national curriculum and consistency in teaching methods to preserve “sovereignty” over educational content. This is not excluding foreign textbook publishers, but it would prefer local production, because it must take into account the age and heterogeneity of local students, especially those from rural areas. Rural and poorer urban classrooms must arrange its curriculum for the possibilities of harvest times, family crises and informal job opportunities within the family. Much like it must be able to use a bilingual approach when the majority of students speak an indigenous language; however, when most students speak Spanish, the minority can learn it from their classmates. (Wolff et. al., 1994)

The World Bank outlines what modern pedagogical practices should incorporate:

- (1) Student must use prior knowledge relevant to the educational experience
- (2) Students must do some free writing or calculating for systematic thinking
- (3) Students must self evaluate their initial work and the teacher should evaluate the final individual or group work
- (4) The local context should be taken into account by students during the learning experience
- (5) Concepts elaborated through the learning experience must eventually be compared with general or national statements

(6) Options must be offered to the student for enhance motivation and thinking and

(7) New concepts learned in the experience must be applied in a new situational for formative education.

To implement new teaching practices successfully it will require the following five criteria. The first is a definitive model with revisions according to need. Development is needed and began by local stakeholders with the aim of expansion. Good communication and coordination with state and national political agencies and administrators is necessary to maintain consistent success. A consensus is needed among all stakeholders from local communities to government agencies with adequate financial backing. The final criterion is that simple solutions are needed while the initiation of modifications should be only when necessary and based on monitored research. The World Bank warns of pilot projects failing if they are not supported from the top or expanded too quickly. (Wolff et al., 1994) In modern classrooms, self-learning modules and a variety of materials are used to teach the basics of reading, writing and arithmetic.

Textbooks and Teaching Materials

The LAC countries are neglecting the provision of textbooks for primary education. This lack of teaching materials is correlated to the deficiency of achievement in primary grade school children. The availability of textbooks and teaching materials is fundamental to the quality and academic achievement at the primary. A typical classroom consists of a teacher writing the contents of the lesson on the blackboard. The children are then required to copy it. If the lesson is not prepared well, by its organization

or sequencing of lessons, the teacher will rarely have the preparation to react to the children's needs of feedback and adjustment the lesson. Alternate and supplemental methods are rarely used in these classrooms. Students do not get the stimulus of small group problem solving or creative writing. In Nicaragua, students who studied from mathematics textbooks scored higher on standardized achievement tests than those who did not have access to textbooks. (Wolff et. al., 1994)

In a study conducted over a five-year period in Northeast Brazil, about the availability of software opposed to educational facilities, teacher salaries and teacher training, it was found that software, or teaching materials were the most cost effective and achieved the most. For every dollar spent on textbooks and educational materials, four dollars were saved from the reduction of dropouts. Undoubtedly, quality educational materials should be the priority. (Wolff et. al., 1994)

It is cost effective to provide textbooks. It has been shown in a study of northeast Brazil that four dollars are saved for every one dollar spent in textbooks and educational materials with the reduction of repetition. As mentioned before, the LAC spends some US \$2.5 billion per year on school children that must repeat a grade. Only Mexico and Chile provide more than 50% of the cost of textbooks from public funds. Mexico provides approximately 75% of children with textbooks through a national textbook program and a national publishing. Three thousand, two hundred and fifty primary schools showed that there was a shortage of 8,800 junior mathematics sets, 2,540 maps, 450 blackboards and 600 rulers. Two-thirds, (2,120) did not have a library. The Ministry of Education in Venezuela provided only 70,000 textbooks to 3.8 million students (2%) by in 1984. Visits from the World Bank to poor urban and rural schools showed that there

were no dictionaries, wordbooks, library books, posters or maps. The only materials were the sheets of paper that the teachers bought themselves. Children from wealthier families had books that their parents bought for them. (Wolff et. al., 1994)

The LAC boasts a 90+% of literacy rate; however, because of poor management, lacks of clear accountability for the purchasing of textbooks, bad evaluation and selection of textbooks, poor quality of content, outdated material, inappropriateness for the curriculum, and inadequate teacher instruction, their education system suffers. The availability of textbooks alone will not solve the problem. The actual implementation of content appropriate textbooks along with teacher training is necessary. (Wolff et. al., 1994)

The World Bank advocates the use of textbooks for several years, which would call for the mass production of textbooks to have a better physical quality. This would increase the upfront costs, but would be more cost effective in the end. They suggest that parents should be responsible for a portion of the textbook's cost to ensure a sense of ownership in their child's education. Presently, in Mexico the production of textbooks is a government operation. They write, design, typeset, produce, warehouse, distribute and support teachers with training. However, the opportunity for private institutions to eventually take this responsibility is favored.

The average textbook lacks in relevant curriculum and is out of contact with the needs of the teachers and their abilities. In Mexico, textbooks made to last one year. They are printed on newsprint paper in four colors. The cover is lightweight, unvarnished cardboard and the binding is glued, not stitched. Policy allows the children to keep their textbooks, which is why they are produced with such low quality and do not typically last

an entire year. Modern pedagogical content and more robust physical teaching materials are needed. Optimally, textbooks would last for at least 3 to 4 years. There is a gradual shift from the rigid curriculum of a textbook and the flexibility and content rich use of multiple teaching and learning materials. (Wolff et. al., 1994)

Monitoring

For the most part, people outside of the region compiled quantitative research from LAC. To gather accurate and relevant data, the countries' education officials should be the ones to assemble research. However, at present there is not infrastructure to comply. The cost of management in school systems is expensive and inefficient. At this time, there is no quality way of monitoring the successes or failures of school systems in Latin America. Improvements will involve a bettering way of monitoring educational progress as well as the indicators such as the availability of textbooks and teaching materials and an accounting of real teaching days and hours and actual pedagogical practices in the classroom. To work, the input and output must be implemented together in order to be complementary. Educators and leaders must identify and define acceptable criteria for educational inputs and services, implement the criteria at its full potential and track the provisions given for further evaluation. This paper does not begin to define how these statistics are used to evaluate, whether samples or universal statistics are necessary. There are arguments for both. The paper merely creates a possibility where data can be collected for use of governmental or non-profit autonomous testing agencies to evaluate and develop improvements for education. There is need for educational assessments, but the information has not been available. (Wolff et. al, 1994)

By monitoring curriculum as well as results, officials, such as the Ministry of Education or the like, are able to regulate or standardize to a certain degree what the curriculum will be. For example, in Venezuela, parents buy books for their children. School directors are supposed to accept only Ministry of Education approved textbooks; however, in practice they must work with what they have. (Wolff et. al., 1994)

CHAPTER FOUR
EXISTING PRODUCTS

\$100 Laptop Initiative

The \$100 Laptop is the brainchild of Nicholas Negroponte in cooperation with the Media Lab at Massachusetts Institute of Technology. Otherwise known as the non-profit group, One Laptop per Child is the organization that is developing a low-cost laptop computer for students in developing countries. It will run with Linux, an open source software, instead of Windows or OS X because it is a free, quality and maintainable platform which allows for the free use and development of software. The laptops will use a mesh-network which will allow up to a thousand computers to link wirelessly with only one or two land-based internet connections. Where Internet signals are weak, Negroponte proposes to use Global System for Mobile Communications (GSM), the same network that such mobile phone companies as Cingular, T-Mobile and AT&T, with a data standard to allow low-cost and educational use. He has signed an agreement with the United Nations Development Program to develop technology and learning resources. He also has the commitment of Quanta Computer of Taiwan to produce the \$100 Laptop with Advanced Micro Devices (AMD) of Sunnyvale, California to produce the CPUs and has close to \$700M from seven nations including, Thailand, Egypt, Nigeria, India, China, Brazil and Argentina to underwrite the cost of seven million laptops. (Markoff, 2006)

Bill Gates has countered the \$100 Laptop idea with what could be a less expensive alternative of using a cellular phone, a television with an adaptor and a keyboard. (Markoff, 2006)

Recently, the design of the \$100 Laptop has been handed to designer Yves Behar (see Figure 3), Swiss born and working in Silicon Valley's San Francisco at his own firm, Fuseproject Inc. He is renowned for the design of Herman Miller's Leaf Light, the Svarovski chandelier that hangs in New York's JFK International Airport.

Design Continuum was first hired by Nicholas Negroponte and resulted in the IDEA Silver award winning Hundred Dollar Laptop Computer; however, Negroponte said, "We got stuck and could not rethink the basics." The environments that these laptops will have to endure include rain, dust and the wear and tear of children. They found that the Design Continuum's effort had too many working parts and that it really needed to be compact and sealed. The crank, a power source for the laptop, was found to be a bad idea because of the stress that it would put on the hardware and the ergonomics of cranking is awkward and unstable. The radio antennas will allow for peer-to-peer networking within a 10-mile radius without the use of a tower or satellite. Behar's version of the \$100 Laptop, includes a sealed rubber keyboard, availability in several colors for the resistance of theft and resale, and the compilation of the motherboard and "guts" behind the display to solve the problem of wiring through a hinge mechanism. The problem with this is that it made it too heavy for children who have to carry it everywhere they go. Behar considered the use of e-ink because it runs on lower amounts of power, which makes it possible to use smaller batteries; however, the technology is not ready for a 2006 production at Quanta. He covers the USB ports with swiveling flap like

antennas so that the ports are covered and protected while not in use. Other criteria include a dual mode display that switches to monochrome mode in bright sunlight and a power scheme that allows the computer to be charged and run without an electrical outlet. These criteria are not yet working together, which delays the production of the slated 5 million laptops. (McGray, 2006)



Figure 1. Three preliminary designs for the \$100 Laptop

Some of the criticism started when Nicholas Negroponte introduced the idea at the World Economic Forum in January 2005. Scientists condemned it to be “unbuildable” and “out of touch with the needs of poor communities.” Behar understands that technology is not a panacea for the world’s ails, however, it is an unreasonable idea that the West has that the rest of the world only needs food and water. There are many places, Latin America; for one, where children are not starving and want an education. On the other end of the spectrum of critics, some want to run a T₁ line in to every town square; however, the \$100 Laptop is based on local networking. Each school will have a \$100 server with 200 Gigabytes of educational material, which will save a country like Brazil about \$20 (minus licensing) per student. (McGray, 2006)



Figure 2. Yves Behar's design for the One Laptop per Child Initiative

Leapfrog's LeapPad®

LeapPad came on the market in September of 1999 at the cost of \$49.99 and out sold the Razor Scooter that holiday season. By selling five million units in 2001,

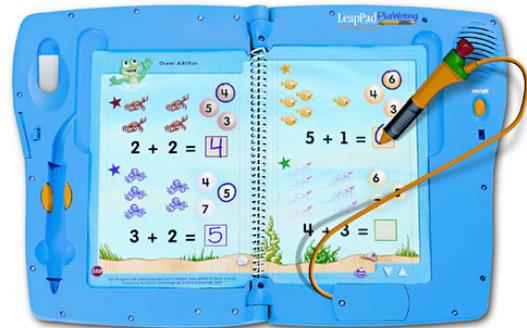


Figure 3. LeapFrog's LeapPad®

its success was equal to the Palm. The LeapPad was the innovation of Mike Wood, a law partner originally, who prototyped a set of flash cards that fit in a window with an oversized keyboard so that his three-year old could learn basic words phonetically. He merged with an electrical engineer, Jim Marggraff, who invented a three-dimensional

interactive globe for his own company, Explore Technologies. The interactive globe used a black paint that conducts a low frequency radio signal. A pointer that acts as an antenna detects the location by the intensity of the signal and speakers would name the country or geographical point. This technology began the educational toy LeapPad®. It is virtually a plastic laptop with a computer chip, embedded software and batteries. There is a library of educational spiral paper bound books available for parents to purchase. Each book comes with a cartridge that inserts into the platform and downloads the book's contents. It is not intimidating for children who use an antenna that looks like a pen to point to certain words or pictures for some type of interaction. LeapFrog® has developed many additional educational tools, such as the Twist & Shout, the FLY™ Pentop Computer and the Mind Station® Connector that works with any of their Internet-enabled products. (Helft, 2001)

e -books

Apple's ipod with the itunes music store has made the mp3 player indispensable and accessible to the masses. This, as well as the ubiquity of cell phones has made it the 'norm' to carry electronic devices and be 'connected.' The digital book is one of the last types of media to become popular in this digital age. E-books have not taken off as producers would have liked;

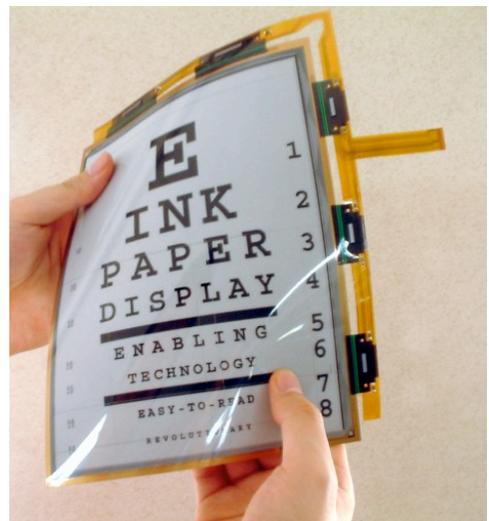


Figure 4. e-ink technology for displays

however, they find that new technology and the burgeoning array of digital books available may make these light and portable readers a success for the near future.

New technology called e-ink allows one to download books and read them with no glare and virtually no energy usage, unless a page is turned. E-ink is a proprietary material which suspends millions of microcapsules no larger in diameter than a human hair, in a clear liquid. Each capsule contains positively charged white particles and negatively charged black particles. A negative charge will bring the white particles to the top of each microcapsule allowing it to be seen. This material can be printed on to virtually any material, including glass, plastic, fabric and paper. It is then laminated on to a layer of circuitry that forms patterns of pixels that can be controlled by a display driver.

The Sony Librie Reader is approximately the size and weight of a real book and Sony offers nearly 10,000 titles. Using e-ink technology allows a user to read an estimated twenty books on one charge. I Rex Technologies, which is a spin-off of Royal Phillips Electronics is also using this technology in their Iliad Reader which allows for reading and writing by mimicking the properties of real paper plus the ability of using the touch screen with a stylus to use as a notepad. It also supports plain text, html and pdfs. (Digital Books, 2006)

						
PRODUCT	S100 Laptop	Pharos Traveler GPS 525	Sony® Portable Reader System PRS-500	Gemstar REB 1100	iLiad	PepperPad
MEMORY	512 MB of flash memory	300 MHz 64MB SDRAM, 128MB ROM	128MB Minimum, 20MB9 Minimum available Hard Drive space, 64MB of internal memory, memory stick capacity.	8MB, Smart Media Card (up to 72MB)	64MB Ram, 128 MB free* internal FLASH memory, MMC slot for MMC memory cards	256MB of SDRAM, 20 GB Disk, SD/MMC Card Slot
PROGRAMS or SUPPORTED FORMATS	e-book mode, VoIP and Skype	Windows Media Player, Microsoft Pocket Excel, Microsoft Pocket Outlook, Microsoft Pocket Word, Microsoft Pocket Internet Explorer, Ostia 7.5 Navigation Software	BBEB Book, Adobe® PDF, TXT, RTF, Microsoft® Word (Conversion to the Reader-requires Word installed on your PC)		PDF, XHTML, TXT, OEB*, MP3,	high-quality browsing, Mozilla, Java 2, Flash and AIM client
CONNECTIVITY	802.11b/g antennas w/ half-mile range	Included: SiRFstarIII GPS receiver, Bluetooth version 1.2, Built-in WiFi technology	CONNECT™ software installed on your PC	Built-in modem, 33.6 Kbps v.34	Travel hub included, connecting to wired LAN, power adapter and PC using USB, Ethernet cable or WiFi broadband	WiFi, USB 1.1 Port, Bluetooth
LIGHTING	LED backlight	Reflective or Transflective LCD, 16+ colors	e Ink®		iRex Technology	
DISPLAY	640X480, 7.5 inch color display or 1,200X900 monochrome for bright light	320 x 240	E-Ink® "Electronic Paper. Approx. 6" Measured Diagonally, 170 Pixels Per Inch, 4-Level Grey Scale	5.5" Diagonal, 320 x 480, Monochrome LCD touch screen	122x163 mm, Electrophoretic technology is a breakthrough for electronic reading (reading in and outdoors) and mobility (light, low power consumption).	800X600 SVGA LCD 8in screen, with touchscreen
MATERIALS	rubberized plastic to absorb shock					
INPUT/OUTPUT	seamless touchpad supports driving and handwriting			Stylus (pen)	Touch sensor input using stylus	tabbed screen, built-in mic, mic jack, stereo line out and video-out. Stylus, keyboard, scrollwheel,
BATTERY	batteries with 5 year lifespan	GPS Mode: 5 hours, Standby time: up to 200 hours, WMV playback: 8 hours, WMA playback: 12 hours, Battery recharge time: less than 4 hours, Type: Li-Ion	Rechargeable Lithium-Ion Battery Life (Approx.): Up to 7,500 page turns. AC Charger requires 120 Volts 60Hz	20-40 hours, non-removable Lithium-Ion battery	Rechargeable battery, three hours a day for more than one week,	Spare Battery, less than two hours on a full charge.
PROCESSOR	366 Mhz processor and 128 MBs of RAM	SC32442X	800MHz Celeron® class processor or better	ARM processor	400MHz INTEL X-Scale Processor	624MHz Intel Scale PXA270
OPERATING SYSTEM	modified Redhat Linux OS	Windows Mobile 5.0	Windows® XP (Home Edition/Professional, Media Center Edition, Media Center Edition 2004, Media Center Edition 2005)	Gemstar proprietary system		Linux-based
COLORS	30 initial colors					
PRICE	\$140	\$449.95	\$349.99	\$300.00	\$812.42	\$800
DIMENSIONS		2.4"W x 4.3"L x .7"D	6.9" by 4.9" by .5	5.0" x 7.0" x 1.5"	155x217x16 mm	12.1X6.6X0.8
WEIGHT		150 grams	9 oz. w/o cover	18.0 oz	390 grams	2.3 pounds

Table 6. Comparative Product Chart

CHAPTER FIVE

THE PRODUCT—AN ELECTRONIC TEXTBOOK FOR PRIMARY GRADE SCHOOL CHILDREN IN LATIN AMERICA

The World Bank's Discussion Papers say that careful experimentation of well-designed innovative models and systematic evaluation of results are also necessary for endorsing specific policies. For example, self-learning textbooks may improve performance for students from lower socioeconomic backgrounds; but may do little for students from higher socioeconomic backgrounds. (Wolff et al., 1994)

The only long-term investment lies in the human treasure (mainly children and youth) and the cultural treasure. (Fasheh, 1999) There is a need to change the perspective and look at the long term goals rather than short term solutions. Children are our client, not the teachers, administrators or governments. (Wolff et al., 1994) The solution is inspired by the success of LeapFrog's LeapPad®, the interest in \$100 Laptop and the need for education in developing countries as a basis for the economic growth and human well-being for the future of the children growing up in these countries. Because resources such as teachers and textbooks are difficult to come by and due to the explosion of technology, it is now possible to design an electronic textbook for primary school age children that they can work with interactively to learn at their own pace with very little teacher training. An electronic textbook will circumvent the problems of environmental waste of paper on outdated or even unavailable textbooks. Lessons and books can be

downloaded for each student. Their progress can be observed for the updating of educational tools or research. Starting at the very beginning of their education, technology will become a part of their everyday life, so that leapfrogging will not be an issue for future generations. The young mind is like a sponge and can grasp so much knowledge; however, if there is no foundation, there is nothing to build. Each child can have a relatively lightweight device that he can take home with him. It will include lesson modules that he can work with interactively or read, just like a book, without wasting paper. A single electronic textbook can hold the year's lessons. He can share it with parents. It can include "advertisements" with service messages on health or community to inform the child and the family. The child can learn at his own pace. If he is talented in math and sciences and moves quickly through the modules it can give him a sense of self-esteem, rather than being held back by the rest of the class. On the other hand, if the child needs extra time or supplemental studies of another subject, this will be available to him also. In rural areas, where children have to miss school because of harvests or when parents are afraid to let their only girl travel to get to school, she will be able to work at home. This is not ideal, but the education is still available to her. The students' progress will have to be monitored by weekly or monthly meetings at a central hub to upload their progress. All of the children's progress can be monitored by a central database that can be used for data or educational research. This is for the primary grade students to gain a sustainable education and be able to phase into the use of the \$100 Laptop. Hopefully, it will translate to all cultures and countries even in developed countries where adults are illiterate or parents decide to home school their children. The assumption here is that interactive lessons will have state of the art educational methods to teach children that

allow teachers to supplement student's studies with group or individual lessons. In the cases where teachers are unskilled, a student independently of an instructor can use the electronic textbook. It is designed this way because of the scarcity of quality-trained teachers in developing countries. The World Bank advises governments to provide at least one textbook in reading and one in mathematics per student and at least two books in a classroom library and possibly textbooks in social and physical science for the latter years of primary school. These minimal requirements along with supplemental materials would cost about US \$5 per student per year. The World Bank also suggests the eventual moving towards a single textbook that includes reading, writing and arithmetic so that the teacher will be able to create their own materials (Wolff et. al., 1994).

Requirements

The electronic textbook is conceived as a primer to the \$100 Laptop; therefore, its operating system can be easily integrated by using the same modified version of the Red Hat Linux operating system. Specifications include a 366 MHz processor with 128 mega-bytes of RAM and 512 mega-bytes of flash memory. (See table 6). Thaddeus Roppel, an electrical engineering professor at Auburn University suggests that the book content can be stored on a memory card so that the electronic textbook would only need a card reader. Dr. Roppel says, "Since the software is pre-determined, it can be stored internally on a programmable solid-state memory chip (PROM), which would make it more rugged and reliable." It will include an LCD screen, speakers, earphone jack and an optional memory card or stick. It will run on a lithium ion polymer rechargeable battery, or power adapter.

The Internet capability that the \$100 Laptop prides itself is omitted for two reasons, to cut down on the cost and complexity of function and the lack of necessity when dealing with 5 to 10 year olds. A universal serial bus (USB) port is necessary to download books and lessons and upload progress reports through either a central desktop.

The e-textbook has been designed with the attributes of endurance and modularity. New innovations in technology quickly make the latest devices obsolete. It would be ideal for each student having an e-textbook to be able to maintain it for the entire five years of their primary education. Inevitably, the e-textbook will be superseded by newer technology, but to extend its life an ExpressCard™ slot has been included. The ExpressCard™ is the standard for modular expansion developed by the PCMCIA, or Personal Computer Memory Card International Association. It is the latest generation of PC card technology. An ExpressCard™ slot gives the user the ability to add memory with card readers, wireless capability, television tuner, additional USB ports or firewire ports (ExpressCard Technology Benefits, 2007).

“Reflective writing of personal experiences is a fundamental activity in integrating language, thinking, and doing. It is the basis of building new meanings and understandings, i.e. knowledge” (Fasheh, 1999). During a child’s formative years, it is important for children to gain writing and motor skills, therefore, a pressure tablet/track pad and stylus is included for the primary input device to emulate the closest adaptation to writing with a pencil and paper. While observing five year olds with computer keyboards, the keyboard was a distraction for them; as a result, the standard QWERTY keyboard is omitted. Buttons are minimal. They include four directional arrow keys and one enter button.

The requirements for the e-textbook were compiled by literary research with the criteria of determining components that would produce a robust and modular device with the longest possible survival. Further research and collaboration with electrical engineers and computer scientists is needed.

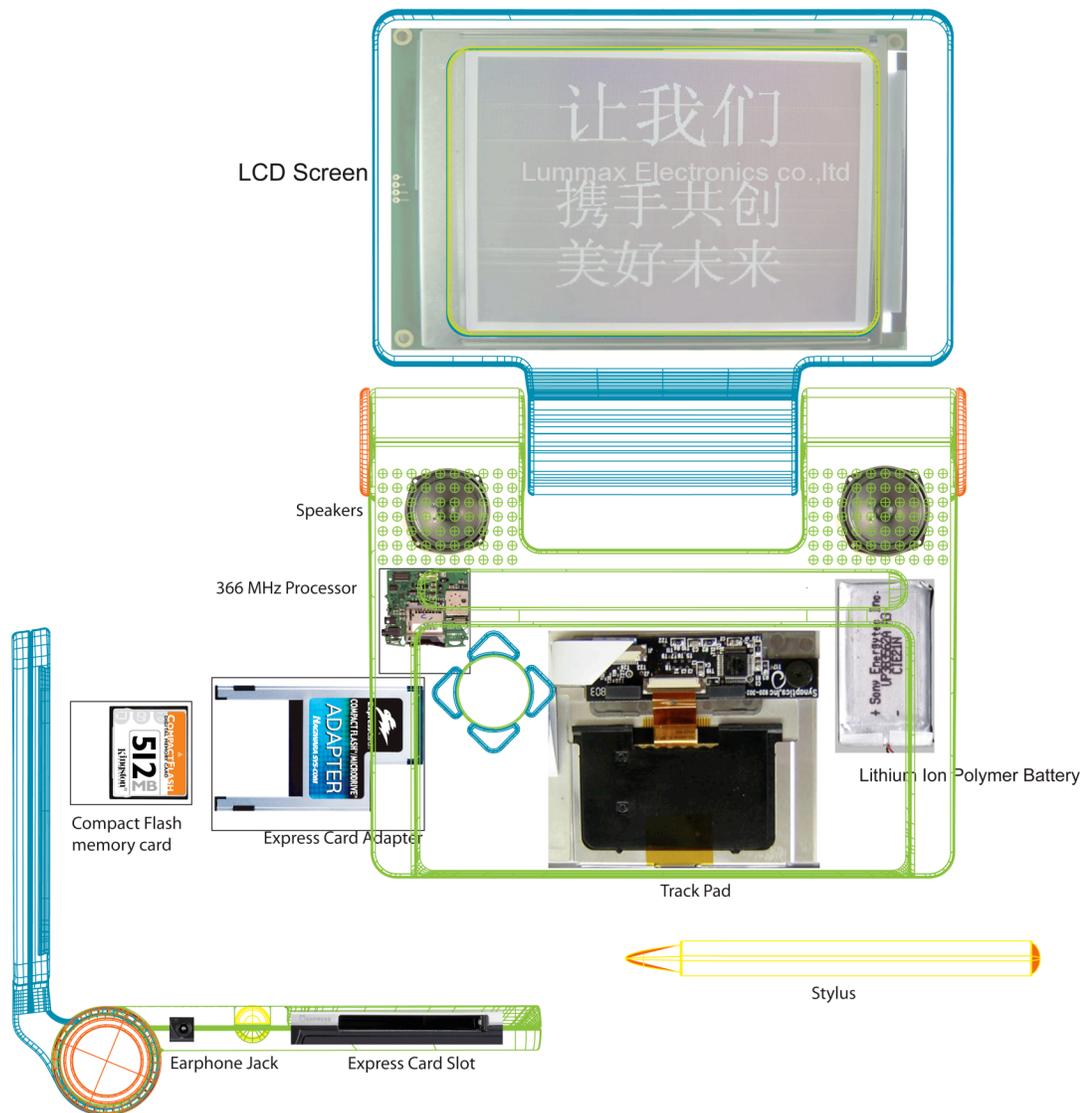


Figure 5. Internal components for electronic textbook

		Parameter	Performance Criteria
Human Factors	Practical/Physical	Size	'=<8.5"X11.2"
		Weight	< 3 lbs.
		Functions	Scroll, Point
		Materials	Sustainable, Durable, Tolerate to hostile environments
		Maintenance	Replaceable Components
	Aesthetics/Cultural	Shape	Ergonomic for children 5 years old to adult
		Colors	Primary Colors
	Social/Economic	Age Group	5 years old anto adult
		Price	\$100
Technical Factors	Direct	Operating System	Red Hat Linux
		RAM	=> 128MBs of RAM
		Screen	LCD display-Transflective TFT (thin-film transistor), variable resolution, color screen, backlighting
		CPU	=> 366 Mhz processor
		ROM	ROM or PRAM
		Battery	rechargeable battery- ion lithium
		Hard Drive	hard drive- flash memory, memory stick or card w/port
		Conectivity	USB Port
		Input device	Buttons and stylus
		Audio	Speakers with phone jack
	Power Source	AC/DC adaptor power cord, possibly to solar transformer	
	Indirect	Impact Resistance	able to withstand impact, drops, liquids, hostile environments
		Safety	no exposed electronics, no sharp edges
		Environmental	only recycleable materials
Supported Formats		PDF, HTML, JPG, PNG, RTF, TXT	
Production Factors	Casing	High volume production, plastic mold injetion	
	LCD	go to Suppliers	
	Electronics	Suppliers, Intel, AMD	
	Software	Linux, Adobe	
	Assembly	In each country	
	Distribution	Shipping	
Marketing Factors	Target Markets	Worldwide Initative	
		Ministry of Education, each country	
		Through Governmental Agencies	
	etextbook advertising	World Health agencies and organizations	

Table 7. Performance Criteria for e-textbook

Designing for a Hostile Environment.

Within the system of the electronic textbook, it is possible that electricity is not available or erratic. In the case of ITC Infotech, an IT company in India, which designed a network of PCs in rural India connecting villages to enable the farmers to communicate, voltage fluctuations created sudden current surges or no power at all. ITC ended up having to use solar power and satellite communications rather than landlines. (Prahalad, 2005) If it is necessary, some type of alternative energy source, such as a solar powered or fuel cell charging station can be developed to recharge the electronic textbooks at each school. Ideally, the electronic textbooks would be able to run on lithium ion polymer batteries because they are rechargeable and less hazardous because it uses a solid polymer electrolyte rather than the organic solvent than the previous generation of lithium ion batteries use. In the case of the electronic textbook, hostile environments may not only concern weather and climate, but also the wear and tear of a five year old or ten year old's use of the product.

Distribution

Access to the schools and the logistics may need as much innovation in the distribution of these electronic textbooks as the books themselves. Prahalad warns that the distribution may “challenge conventional wisdom.” Textbooks are stored in publicly owned warehouses and privately owned tractor trailers, and some trains transport books to central warehouses in each of Mexico's capital cities. Beyond this, distribution becomes difficult. The rural areas are the most problematic for distribution since rural families are the poorest, costs are higher and private investment is not interested in rural

areas. After the initial distribution of the electronic textbooks, more could be sent by simply mailing or downloading files to distribute the materials, or files can be done easily by compact disc or flash drives. Logistical problems of distributing cumbersome textbooks or letting them rot in public warehouses without being distributed will not be a problem. (Wolff et. al., 1994)

Interface for Children

Developing countries seem to be very adaptable to new technology because they do not have to compare it to old technologies. For children with little or no exposure to education and no interaction with technology, the interface design is an important part of the success of the electronic textbook and the child's education. The design of the electronic textbook, its metaphors and affordances should be as relevant to original as possible. For example, this product could be termed a learning device; however, for the context of education and schools it is an electronic textbook, therefore, its styling should be reminiscent of the textbook used in schools. Perhaps in the future, only keyboards will be used; however, the main input device for the electronic textbook is a stylus for the purpose of teaching young school children writing skills, hand-eye coordination and to mimic as closely as possible the original tools of education, the book and the pencil.

Modular Lessons

Modular lessons specifically address the high repetition rates among primary school children. Evidence that teachers raise the standards of passing as learning increases, can be counteracted by students passing each module instead of an entire year

of studies. Modular lessons will solve the problems of multi-grade classrooms by allowing for supplemental group projects among students.

A standard of skills must be mastered to move on to the next module or the next grade; however, with an electronic textbook students can learn at their own pace. Some students have a better aptitude for mathematics while others excel at language arts. Some students will not stay motivated even though they are smart, and become bored while the teacher must teach to the common denominator of students. If they work at their own pace some of these problems can be alleviated. Student A can keep working through his modules and does not have to wait for the rest of the class. Student B may excel in mathematic skills while needing supplemental lessons in language skills. Module lessons can be developed on the fly or over time through administrative monitoring. However, they are developed, it can be much faster and distributed much more quickly than waiting for the life of a textbook to expire.

Monitoring Students Progress

By creating modular lessons in electronic form, the prospects of monitoring a student's progress at a host of different levels is possible. For the student there is a sense of accomplishment and possibly a challenge through instant feedback. For the teacher there is instant feedback of the child's aptitude for each lesson without having to spend the time to grade individual papers (unless it is a subjective type of lesson). For administrative purposes, there is a record of each student, how much and how well he or she is doing. Also, there is the ability to assess the efficacy of each lesson so that it can be further developed. At the national government level and even international level. The

progress and viability of such a program can be assessed and documented easily through a central database with information on each child.

Training Unskilled Teachers

While it would be ideal to have well-trained teachers for each classroom this is not always a possibility in the smaller rural villages. Even in urban settings where the population is dense, teachers are not as available due to administrative duties or large classroom sizes. Prahalad advocates the deskilling of work. This is not to say that teacher training should not also be a priority; however, for these purposes, at the present, the electronic textbook would be virtually self-sufficient based on a user-friendly interface. Because students may not have the skills to read or be limited by language and teachers, parents or volunteers may have reading, writing and arithmetic skills but may not be skilled in teaching them, the interface needs to be designed with the idea that the skills of those working with it will be limited. (Prahalad, 2005) Where skilled teachers are available, the electronic textbook will enable the teachers to supplement the lessons of the electronic textbook with group sessions or individual teaching. This can be advantageous in multiple grade classrooms and allow teachers more individualized interaction with their students. Where available, teachers, parents and volunteers should have the availability of expert advice with lessons, behavioral problems or teaching alternatives via the Internet. For the seasoned teacher, the electronic textbook can also supply the resources to create, develop and distribute their own teaching materials.

Community Awareness

Beyond the possibilities of children without a solid educational infrastructure being able to learn for themselves, the electronic textbook can also be used as a forum for service announcements. For the purpose of financing some of the costs of the electronic textbook itself and getting information out to communities that may be in media dark areas, governmental agencies as well as corporations can advertise on the electronic textbook.

For example, in India, there is a company called Hindustan Lever Limited, which has grown to produce the much-needed consumer goods needed. It was HLL's mission to educate the community. By teaching the children to wash their hands with soap and water two million children would not have to die of diarrhea each year. They used teachers, NGOs and their own employees to go to classrooms and teach children how to wash their hands. The children then became the ministers of the community on hygiene, meanwhile HHL sold more soap. (Pralhad, 2005) Using the electronic textbook to advertise community services and information could reach the population at the base level, pay for itself and teach the next generation.

Sustainability

<http://en.wikipedia.org/wiki/Sustainability> defines "sustainability" as

an attempt to provide the best outcomes for the human and natural environments both now and into the indefinite future. It relates to the continuity of economic, social, institutional and environmental aspects of human society, as well as the non-human environment. It is intended to be

a means of configuring civilization and human activity so that society, its members and its economies are able to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, and planning and acting for the ability to maintain these ideals in a very long term. Sustainability affects every level of organization, from the local neighborhood to the entire planet. (November 26, 2006)

Selling to the BOP is not about producing a lower standard product at a lower price. It is about producing a high quality product so that it fulfills the needs of function and reliability, so that the needs of the bottom of the pyramid are also fulfilled.

Sustainability is not merely a trend to be applied to the designing for the bottom of the pyramid. It is a necessity. As industrialization moves to industrializing nations, the sins of the developed world must not immigrate with it. Indigenous societies are already apprehensive about progress if it means that their connection to the earth will not be respected. The sheer multitudes of population who can benefit from development can also be destroyed if a sustainable attitude is not incorporated in their development.

Products designed for the BOP cannot be disposable. The average American produces 4.62 pounds of waste per day. If the Chinese generated the same amount of waste per day there would be some 5.5 billion pounds of waste per day (Prahalad, 2005).

In 1996, one estimate showed that the merging middle class of China, India, Venezuela, Brazil, Argentina, South Korea, Taiwan, Indonesia, Malaysia and Thailand equaled approximately 750 million people. By the year 2020, China could have 400 million more cars. Two main approaches for sustainability while development and consumption grows are the ideas of eco-efficiency, which allows for the production of

more goods out of the same or less material and eco-sufficiency, which tries to get the same welfare out of fewer goods (Robbins & Leeuw, 2001).

The electronic textbook being developed for this thesis can adhere to both eco-efficiency and eco-sufficiency. The concept of an electronic textbook initially bypasses the use of natural resources spent on the manufacturing of books. Where books are in short supply already, the resources that would make paperback books sustainable, i.e. easily recycled and printed without toxic inks or glues for binding would make them even more scarce for student use. Secondly, each child would need a textbook for each subject and each grade. These would need to be updated and produced every three to five years to maintain purposeful pedagogy practices. The electronic textbook, ideally, will be produced with only the most robust and reliable engineering. Its function is pared down to the essentials. The cost and unreliability of extra features are not necessary and undermines the sustainability of the concept.

From IDSA's Ecodesign Okala Curriculum, the Ecodesign Strategy Wheel outlines a product's lifecycle. There are seven strategies a designer must practice in order to optimize the lifecycle of a product.

- (1) Design for innovation by rethinking the benefits of the product. Can the product features be shared? Can the features be provided in a non-material way, i.e., a service? Can flexibility be integrated into the product for future technology?
- (2) Design for low-impact of materials. Can materials that impact human health or global resources be avoided? Can you use fewer materials? Are the materials readily renewable? Can they be reused or recycled?

- (3) Design for optimized manufacturing. Can it be designed for ease of manufacturing? Can manufacturing waste be reduced? Can energy use in manufacturing be reduced? Can the number of production methods be reduced? Can the number of components/materials be minimized?
- (4) Design for efficient distribution. Can the weight of the product and packaging be reduced? Can the packaging be recycled? Are you using an efficient transport system? Can it be produced and assembled locally?
- (5) Design for low-impact use. Can you reduce energy use inefficiencies? Can cleaner energy resources be used? Can renewable energy resources be used?
- (6) Design for optimized lifetime. Can it be designed to foster a user's desire to care and use the product for a long time? Can it foster sentimental value and improve with age? Is it durable? Is it maintainable and easy to repair? Can it be upgraded? Can it have a second life? Is it timeless in design?
- (7) Design for optimized end-of-life. Can it be recycled as the same product or for materials? Will it be collected? Is it biodegradable? Can it be disposed of safely? (Okala Ecological Design Course Guide, 2004)

The innovation of the electronic textbook, by sustainable means, is its replacement of the multitudes of paper made books that it would originally take to serve the same purpose. Its manufacture can easily avoid the use of materials that would harm either humans or the environment by choosing recyclable and biodegradable plastics. It is designed with minimal components, both electronic and plastic. It can be easily assembled and disassembled for the purpose of replacing defective or damaged parts to

ensure longer use of the electronic textbook. Ideally, for the greatest sustainable and economic return, it would be manufactured and assembled in Latin America.

Realistically, for the lowest cost, parts would be compiled from around the world and assembled in Latin America.

Unfortunately, all electronics and their technology are relatively short-lived and for an elementary school student not many possessions are valued for long. It is difficult to predict whether an electronic textbook can ever replace a hardback text for sentimental value. The electronic textbook, if widely accepted can play an integral part in the making of a new era in education thereby creating a nostalgic sentiment for a generation just as the vinyl album can for this age of the compact disc or MP3.

Conclusion

Neither the education of children to further the development of the next generation nor the production of a portable electronic device is a new idea. However, it is an innovative application of using an electronic educational toy to solve the problem of political and economic development. It is about education as the solution to economic strife. How can a conscientious industrial designer help the world's poor? How can an outsider make decisions for others? How do you decide what product will make the most impact when so much is needed? How do you do the least amount of damage? You give them the tools to help themselves.

The decision to create an electronic textbook for primary school students in Latin America was born out of a want to design for the Third World, but research leads to apprehension that someone who does not come from Latin America or poverty cannot

really understand their needs or the entirety of their culture. Research clearly points out what the problems are. There is an abundance of children getting through the school system without a quality education due to a lack of skilled teachers, teaching materials, namely textbooks and a system that cannot determine who they are. This is not unlike the problems of any nation. Latin America was chosen because of their proximity to the United States, and their industrial and middle class emergence.

It is an assumption that most problems can be solved with education. The methodologies that industrial designers use incorporate human, technical, production and marketing functions for the innovation of products based on educated research of the psychological, physical, and cognitive factors of human needs. The problem that occurs when industrial designers design for different cultures other than their own is a lack of knowledge of these factors. However, the research for technical, production and marketing functions are basic to all. The components necessary to create an electronic textbook are the same for all cultures. The content differs, so that task is reliant on the educators of Latin America. The production of the electronic textbook uses sustainable tenets that will harm neither the people nor the environment. The functionality and reliability that are incorporated in the design and production meet the hierarchy of needs for a student to reach his potential. The economic returns that are possible through a nation that is educated as well as the corporations that may profit from the bulk production of the electronic textbook or advertising for their own products on the electronic textbook is a tremendous marketing tool.

The electronic textbook capability to work interactively with children is valuable to the student by allowing him to learn independently. It is advantageous for the teacher,

skilled or unskilled, to maintain a large or multi-grade classroom while still having time to work with individuals or groups. It is applicable to the child who cannot come to a school because he lives rurally or must work for his family. The electronic textbook is not exclusively for developing countries. It can also be used for home-schooled children or illiterate adults. The system design allows for the student's progress to be monitored for the instant feedback to the child, the teacher and the administrators. The development of the electronic textbook allows for a quality education for children who would otherwise not get one.

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Graphic_LCD_module. image from online resource,

http://img.diytrade.com/cdimg/237591/2706493/0/1157620848/Graphic_LCD_module.jpg

ion-lithium polymer battery. image from online resource,

<http://www.pspilot.de/pppm505/pppm505.html>

LG.Philips_LCD_E_E_Ink_Flex_Tablet_Display. image from online resource,

http://www.eink.com/press/images/image_release_87.html

LEAPPADP. image from online resource,

http://www.toyretailersassociation.co.uk/toysxmas/pre_school.htm

Yves Behar's design for the One Laptop per Child Initiative (2006, August). image from publication, *Wired*, article The Laptop Crusade, author McGray, D.

Three preliminary designs for the \$100 Laptop (2006, August). image from publication, *Wired*, article The Laptop Crusade, author McGray, D.

APPENDIX
e textbook Development

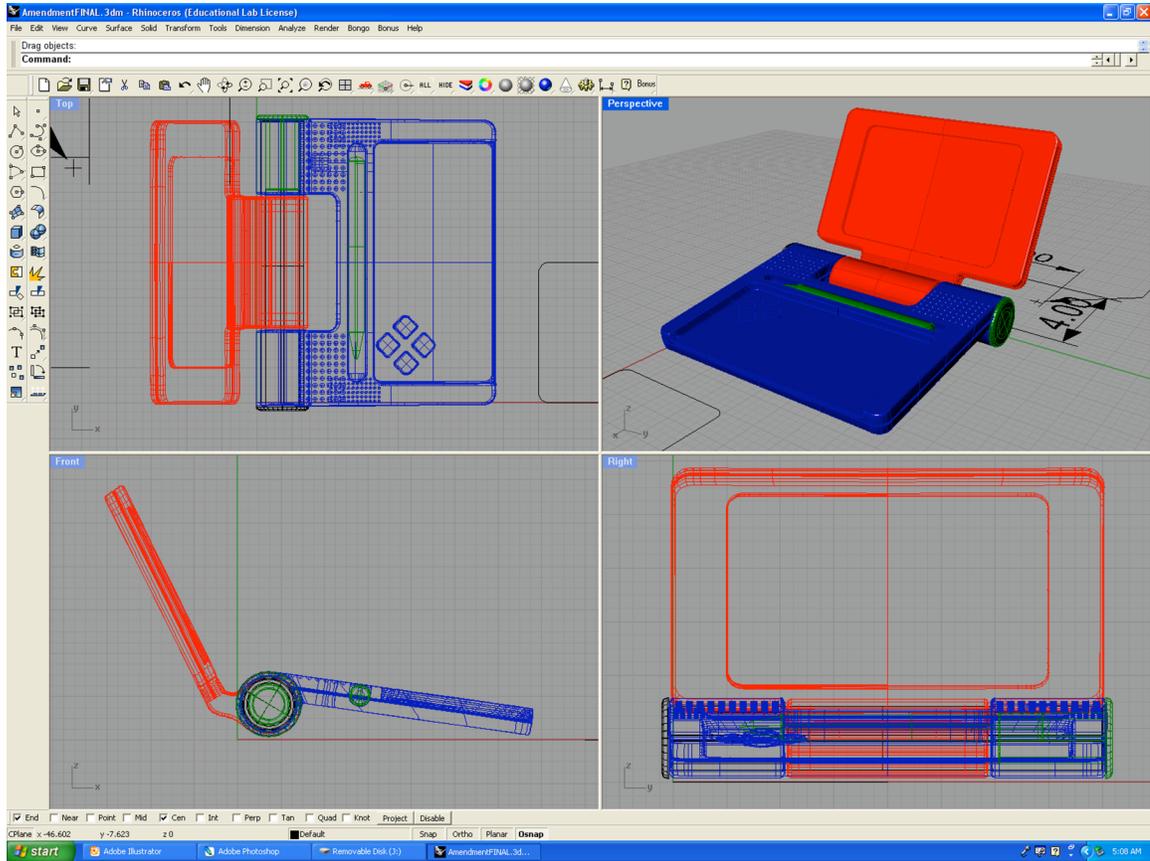
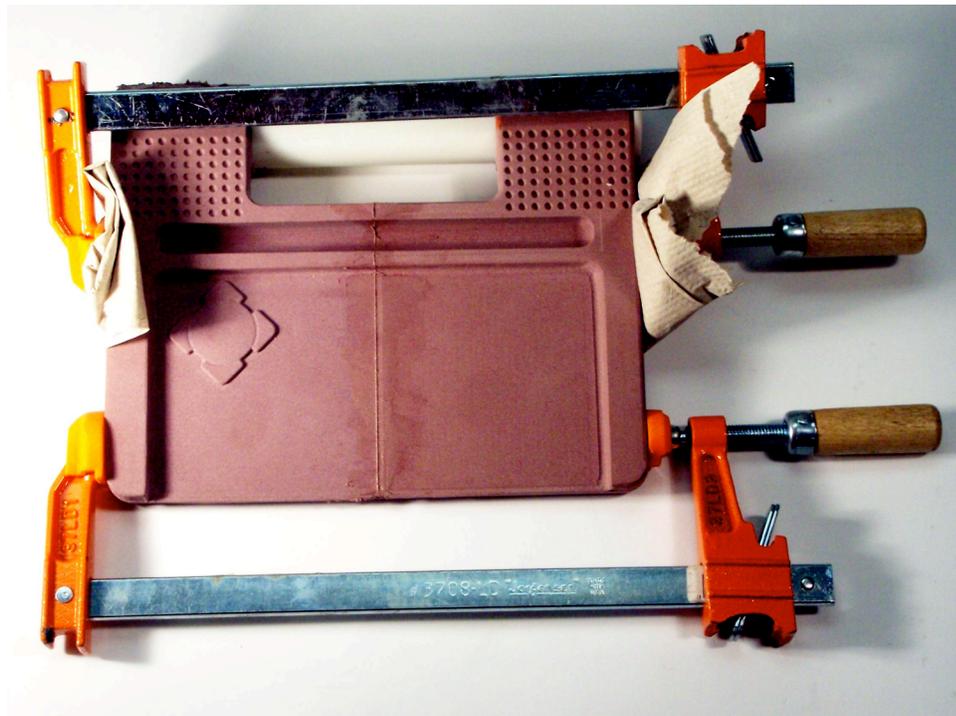


Figure 6. The e textbook was modeled in Rhinoceros 3.



Figure 7. The parts were milled using RenShape 450 on a Roland CNC Router



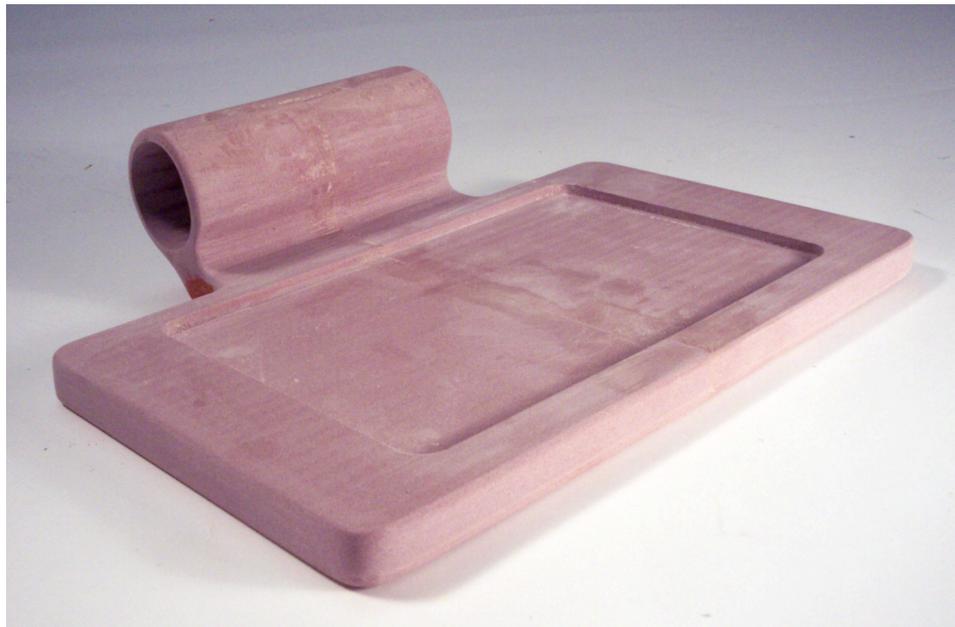


Figure 8. Milled parts were joined with a resin and hardener paste

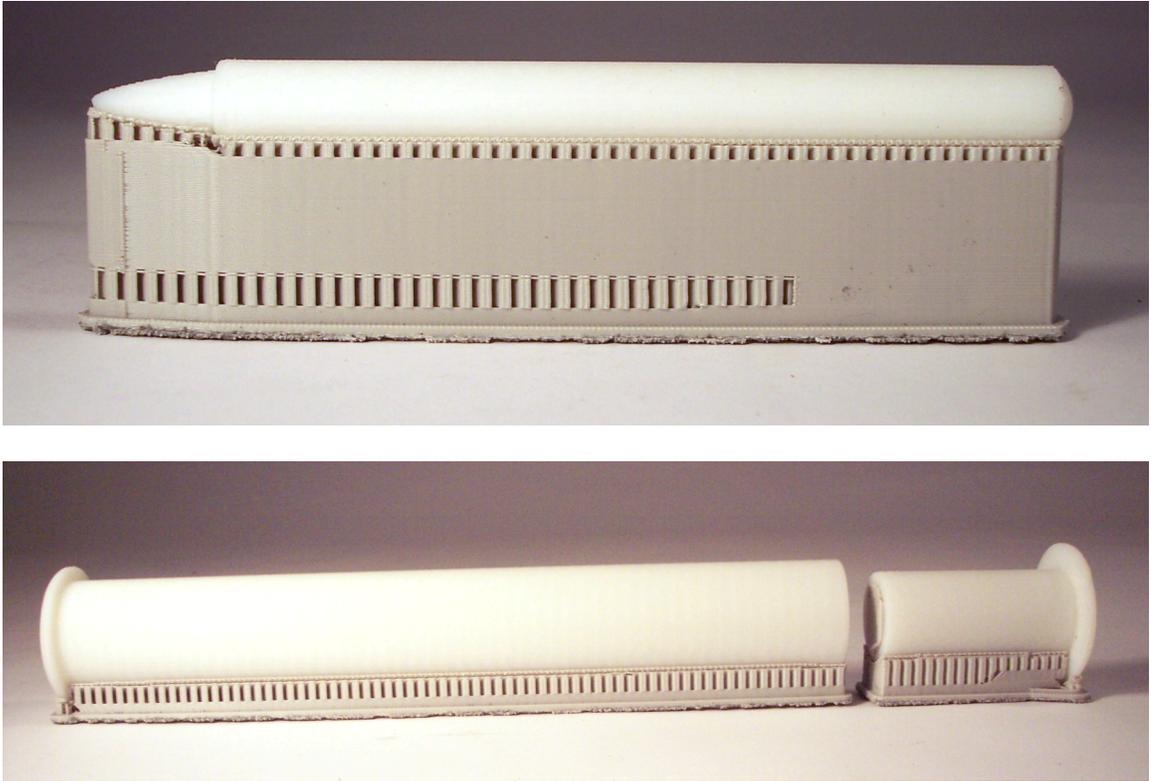


Figure 9. The connector tubes and stylus were 3D printed



Figure 10. The model was sanded and primed



Figure 11. Final model showing front view (open)



Figure 12. Final model showing the sideview



Figure 13. The final appearance model of the e-textbook

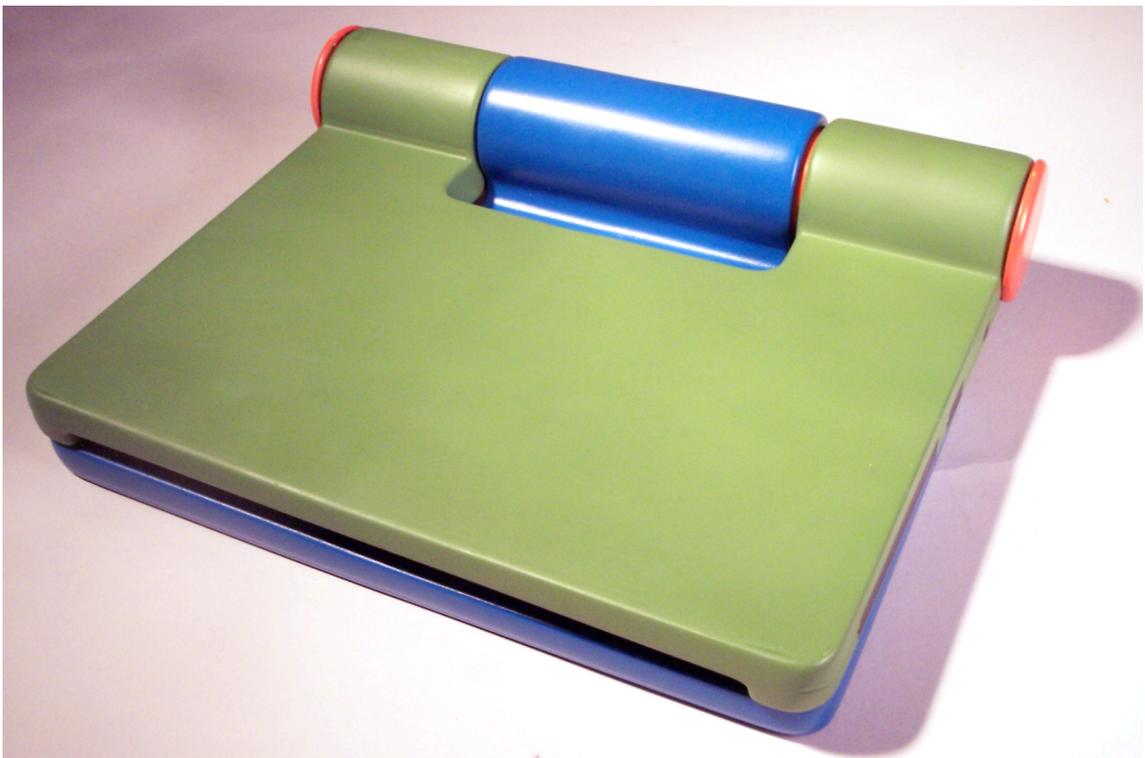


Figure 14. Final model showing view of the underside



Figure 15. Final model showing optional position to view LCD screen



Figure 16. Appearance model of the e-textbook