COMPUTERS AND LITERACY IN SENEGAL

by

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ABSTRACT

This thesis reports two exploratory studies on the use of computers in education in a
third world context. One study looks at elementary school children in Dakar in order
to elucidate a set of research questions such as whether there are gender
differences and whether these are the same as what has been observed in the
United States, whether there are differences related to social status or to degree of
assimilation of French education and, more generally, whether it is possible to
identify influences of Senegalese culture on the way children learn to use
computers. The second study looks at two groups of illiterate adult women: one in
Dakar and the other made up of immigrants from Latin America living in Boston.

I believe that my results cast some light on scientific questions about how cultures
affect learning. But my own interest goes beyond simply understanding. I want to
develop educational methods that will use our diverse cultures as sources of
strength for new educational methods rather than seeing them as "obstacles" to the
exportation of ready made educational methods from "developed" to "developing"
countries. My explorations are chosen with this intent and my thesis is colored with
preliminary speculations about how to realize it.

Thesis Supervisor: Seymour Papert

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To Papou, Adja,
Ndeye Amie and
El Hadj Dame

IV

Acknowledgements

I wish to express my deep appreciation to my father and my mother for their understanding, encouragement, prayers and willingness to take care of my children while I was away. My special thanks to my brothers, sisters and Senegalese friends who did not give my children the time to think of their mother's absence by fully accomplishing their role as true African aunts and uncles.

I owe respect and love to my children Papou, Adja, Ndeye Amie and El Hadj Dame and the children of Senegal. My struggles have been to further the development of their aspirations.

Finally, my deepest gratitude to my husband Doudou, whose help, understanding, encouragement, patience, trust and love kept me strong through my experience abroad.

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CHAPTER 1

INTRODUCTION

In her book Perception and Cognition: A Cross-Cultural Perspective, Barbara Lloyd said: *"People in developing countries are demanding a rapid increase in Western-type education. Studies reviewed here indicate that children from Westernized homes with educated parents will be at a distinct advantage in such a system and it can only be hoped that those without these priviledges will not be stigmatized as deficient. Secondly, in the rush to acquire Western skills it is possible that the unique indigenous adaptations to particular situations will be lost or treated merely as stumbling blocks. Psychological research directed to uncovering the assets of particular cultural environments may at first glance appear a luxury but it could prove the means to avoid some of the mistakes which are currently posing serious problems in many culturally diverse modern societies."*

Senegal is one of these developing countries located in West Africa. It was a French colony for centuries and became politically independent in 1960, following an agreement between the French government and the Senegalese authorities.

As an African country, Senegal is a complex culture, mixing African mysticism with two religions of external origin, one occidental (Christianity) and one oriental (Islam). This diversity of origin marks the educational system and the way people learn and think about everything from politics to the economy and

sociology. The conflict mentioned by Barbara Lloyd between new education and old values is constantly present. To my mind it is obvious that Senegalese cultural values give people a uniquely valuable mental eqilibrium even though some customs have a negative impact on people's thinking, on their lives and on the way they pick up new influences. This paper describes some explorations in the interaction of one such new influence, namely the computer, and especially its use in education, with aspects of the cultures in place. The purpose of my explorations is always to find out how the new can be shaped so as to strengthen and be strengthened by the traditional instead of entering into conflict.

1.1 OBJECTIVES

This essay, the work it reports and all the work I have done at M.I.T. is part of a larger enterprise. I am a Senegalese woman and feel myself to be organically identified with my country and my people. As someone who happens to have become aware of computers and their uses in education I have to ask myself how what I have seen can be understood in terms of the needs of my people. In the following pages I report on two aspects of the work I have undertaken in this spirit. One aspect is experimental. I have conducted some field studies in which Senegalese people, children and adults, have a computer based learning experience. The other aspect is more speculative and is a first attempt at formulating a national policy. I begin with some remarks about the connection between the two.

There may be a "scientific" approach which sees the gathering of data about how people learn with computers as logically prior to the task of policy formation. And everyone knows the opposite approach: let policy grow as an expression of national or personal ideology and worry about facts later. I cannot subscribe to either of these approaches. The two must go together. We have to be thinking about policy letting ourselves be guided by the information we have even if it feels insufficient. The purpose of this essay is to offer the most transparent window I can onto where I happen to be on each of these fronts. I would like to share my observations and analysis about one way of taking thoughtful actions inspite of the richness and complexity of the subject.

1.2 SOME RESEARCH QUESTIONS

I look at computers being used to enhance education in Europe and the United States and I try to understand what I see in terms of our Senegalese situation. Of the questions I ask the most focused is whether any of the presuppositions of this work with computers and learning simply don't apply in Senegal. Or perhaps they apply only to that part of the population that, in a certain sense, needs the help the least: the ones who have already assimilated a high degree of the Western culture of which this computer is a manifestation. In other words is it transferable at all? Besides these more focused specific questions there are more general ones. On the assumption that computers can be integrated into our learning process, will cultural

differences manifest themselves in how people appropriate the computer? Conversely to questions about possible obstacles to transfer one must allow the possibility that things might in some, or even all, respects work better in Senegal. And, of course, from a policy point of view the point is not simply to understand cultural differences but to seize on them as means to do things differently, in ways that in our context may be better.

In the past, the introduction of technology in Senegal did not take into account the Senegalese cultural values. This makes it harder for Senegalese people to integrate any new technology into their society.

Having to confront the worldwide computer culture, the Senegalese government launched a research project in the use of computers in education. This project focuses on the sociological, epistemological, pedagogical and psychological aspects of introducing computers in Senegalese schools. In this paper, I put aside economic aspects, not because they are not important but because they are conceptually separate. The software used in this research is Logo, a computer language which is interactive, procedural and easily usable by children and beginners. Another issue I do not raise is whether the phenomenon I discuss in this research could be seen through other software. My purpose is first to understand what can be done. The cost and the perfect instruments to be used can be studied later.

Research on how illiterate adults react to and learn with computers shows the importance of placing the learner in a learning environment which embodies the cultural values. It also points out how an appropriate use of computers can stimulate thinking and raise consciousness.

What are the possible obstacles to computers being used in Senegal as they are used in the United States?

I see several. Each is based on a hypothesis about what makes the computer work in the USA. Although my data is of a very preliminary kind, and although my intention is to understand my own problems, I suggest also that the findings might throw some light on how American researchers might think about the computer.

These different "obstacles" are couched here in the form of a list of the research questions that weave their way through all the following pages.

THE QUESTIONS

(1) In America, the computer is a familiar accepted cultural object. This makes it accessible and meaningful to learners whoever they may be. In a society where the computer is not familiar or is seen as exotic it may be less easily acceptable.

(2) A more specific issue of the same sort concerns the ludic character of the computer. Many computer based learning materials, especially those directed

at children, try to exploit the "game-like" or "toy-like" aspect of the computer. Children are used to toys and games. This is another one, so they become involved. But the question arises: whose kinds of toys and games is the computer like? American or Senegalese?

(3) The above issues refer to the relationship of Senegal to technologies. The next has to do with the relationship of Senegal to styles of learning. Our models of learning are rooted in religious practices (Koranic learning) very different from those of America. So, what will be the interaction of the use of computers with Senegalese learning styles? Will computers change the learning style? Will the Senegalese learning style enhance or subvert the uses of computers we see in the United States?

(4) In the same spirit there is a general epistemological issue. The theory of knowledge in traditional Senegalese society has much less room for the idea of knowledge as something that grows and changes. Rather it is something that has been fixed for all time. Nor is it seen as something that belongs to the individual and forms in the individual mind. The questions are: will the use of computers in Senegal promote critical thinking and growth of ideas? Or, will the Senegalese epistemology undermine the effect of the computer in this respect?

(5) Koranic education explicity excludes women. What effect will this have on how women take to computers? One might anticipate a negative effect since

girls are less accustomed to the idea of formal learning. One might also anticipate a positive effect insofar as the Koranic education might have negative effects so that those who have not experienced it may be more successful.

(6) More generally, the question of gender differences has shown itself to be a central issue in computer based education anywhere. In the US it is widely believed that boys gain more than girls. How does this issue transpose to Senegal?

(7) A very different kind of possible obstacle refers not to something positive that may be lacking in Senegalese culture (familiarity with computers, certain kinds of ludic experience etc) but to something negative that is actively present. In the United States, there is a positive attitude towards technology. It is true that some intellectuals have criticized its use. But people accept their cars, television sets, refrigerators, washing machines, etc, as part of their natural life. I believe that the acceptance of technologies in Senegal has been colored by the history of relationship between Senegal and the countries who are seen as the bearers of the technology. There were struggles against early technologies such as the railroad tightly linked to the struggle against slavery and colonialism. Will the Senegalese resist computers?

(8) Gender differences are one component of what is becoming known in the US as "the equity issue." Another is the fear that the computer will widen

rather than narrow the gap between the already privileged and the underprivileged in access to knowledge. There is every a priori reason to raise the same question in Senegal. Will the computer bring advantages only to those segments of our population who have already acquired a sound basis in Western knowledge or can it be used as a tool to bring this kind of knowledge to those who have not?

(9) Another issue concerns the effect of computers on learning and raises another question. Does the computer have negative impact on learning? Do children become "isolated"? What will they learn? Does the computer undermine traditional oral culture?

(10) The issue about learning is related to teaching. What will be the teachers' role? How will they feel? Will they think that they will lose their authority?

(11) Finally, I mention a question that many people see as the crux in educational problems in the Third World: what language is to be used? This is not an obstacle for most of the American children because the language of the technology they are using is English, their native language. For the Senegalese children, we have to ask which language to use; French or native languages?

1.3 OVERVIEW

This study addresses these issues and it is divided into 5 sections :

1- INTRODUCTION

In the introductory chapter, I explain the reasons of this study and raise several questions about the use of computers in Senegal.

2- SENEGALESE BACKGROUND

I begin with a brief description of the Republic of Senegal. It touches on geography, population, economics, the history of technology in Senegal, and the existing educational system. I want to emphasize how education is affected by traditional values and of what kinds of innovative efforts have been made up to now. Some of the material presented here is directly related to the research issues mentioned above. Some of it is included for less defined reasons. It is not in the nature of my style to talk impersonally. If I am to present a study, I think it may be relevant to know me (including my culture) a little. This remark applies even more to the postscript where I talk about my personal development.

- THE "COMPUTERS IN EDUCATION" PROJECT

The first two chapters have presented Senegalese education without the use of computers. Here, the introduction of computers is discussed. First, I

address my research questions by describing two field studies:

* A study of children in which some comparaisons are made between groups from different cultural backgrounds.

* A study of illiterate adults. To study how cultural differences affect the ways people approach the computer, two groups of women from different Third World countries are compared. One is Senegalese and lives in Dakar, Senegal. The other group is Hispanic from Latin America and lives in Boston. Each group used the computer and the same software to learn a foreign language.

4- POLICY FOR SENEGAL

In the concluding section, the focus is on imagining a possible Senegalese environment- rich in technology tools and respectful of the traditions- where effective learning can take place.

5- POSTSCRIPT

I use my own childhood experience to show how Senegalese social values (the extended family) can stimulate and support learning for all children whether or not their parents are educated, supportive and/or wealthy.

CHAPTER 2

SENEGALESE BACKGROUND

2.1 <u>GEOGRAPHY</u>

Senegal is a Third World country located on the northwest coast of Africa. It surrounds Gambia and is bounded to the northeast by the Senegal River which represents a natural frontier with the Islamic Republic of Mauritania, to the southeast by the Faleme River, which serves as a border with the Republic of Mali, and to the south by the frontiers of Guinea Bissau and the Republic of Guinea.

2.2 <u>POPULATION</u>

The population was estimated at 5,660,700 in 1980, representing an average density of 28.7 inhabitants per km^2. The population growth rate was 2.8 % and life expectancy 42 years. The population is a compound of different ethnic groups : the Wolofs, the Pulars, the Soninkes, the Serers, the Mandings, the Diolas, the Maures, the Lebous.

Each ethnic groups has its own native language. However, Wolof is widely spoken in Senegal and Gambia by different groups. French is the country's official language.

More than 80 percent of the population is Moslem. The other principal religions are Christianity and Animism. The influence of the minority religions

cannot be measured statistically since in Senegal both Islam and Christianity are mixed with Animism.

Senegal was a French colony until 1960, when it became an independent country. Its present governmental structure is presidential and decentralized. It is one of the rare African countries in which freedom of expression exists.

2.3 ECONOMY

Senegal imports rice, wheat, fruit, vegetables, milk products, drinks, tobacco, chemicals, fabrics, readymade clothing and machinery. It exports fruit, vegetables, sugar, sea food, phosphates, tobacco, leather, cement, clothing and shoes.

2.4 THE HISTORY OF TECHNOLOGY IN SENEGAL

Senegal is one of the numerous victims of the industrial revolution in the Third World. Most of the Third World people cannot use machines to meet their needs because of their habitual resistance to any new technological tool.

It is impossible to ignore the fact the Senegal was one of the first places where slaves were traded. This plus the phenomenon of calling Western-thinking Senegalese "Whites" (Tubab) establishes a historical negativity which is aggravated by the first attempts of introducing technology into Senegal by the French.

The story of Lat-Dior Ngone Latyr is well known among Senegalese. Lat-Dior was a young "Damel" (Chief) of a vast Senegalese area called Cayor. He is famous for his courage and resistance to colonialism and to the railroad.

In 1878, when the French decided to build the Cayor rail road crossing , Lat-Dior resisted strongly. The French explained to him that the railroad will allow easier access to the other parts of Cayor and the country, and that this would aid the development of the agriculture in this area. Lat-Dior understood that under this claim were hidden colonialist interests. The French government wanted to have more control over his country. For this reason Lat-Dior called the indigenous people to organize a revolution against this enterprise.

In 1882-1883, his group fought against the French who had more sophisticated weapons. To face them, Lat-Dior had only sticks, but his strategies in organizing traps confused and frustrated the enemy. Nevertheless, he was asked to leave Cayor in 1884 to go to Djolof, another kingdom. The French put another Damel, Amari Ngone Fall, in his place but the indigenous people opposed this action and the French had to get rid of him and replace him with Samba Laobe Fall. Samba Laobe Fall authorized the construction of the rail road. Despite this, he was killed by the French lieutenants Chauvet and Spitzer.

Proud of this achievement, the French informed Lat-Dior that he could no longer live in Cayor. In 1886, Servatius, a French leader, took over Cayor. Lat-

Dior protested against this decision and started a revolutionary movement to liberate this land and recover his rights and dignity. He was killed on October 25th 1886, with his two sons and 78 of his companions by a troop commanded by Captain Valois.

This is how technology has been introduced to this country, by force and blood; it was a real revolution. People's resistance to technology can take a form of an indifference to it. Yet, the technology invades their environment and lives. Ignorance of the technology can lead to feelings of oppression. Thus, technology increasingly comes to symbolize the negative forces in the society. We can see that it is not a resistance to technology itself; it is who is introducing it, how and for what reason it is being introduced. It is hard for people to separate an analysis of the technology from these emotionally charged factors.

In the next section, I discuss examples of how these negative attributes seem to undermine the introduction of computers in education. The section amplifies question 7 of the list of research questions.

2.5 <u>THE</u> <u>EDUCATIONAL</u> <u>SYSTEMS</u> <u>IN</u> <u>SENEGAL</u>

2.5.1 <u>Presentation</u>

In Senegalese villages, needed skills are taught by doing. Men teach boys how to work on fields, dig a well, cut a tree, build a house, etc. Women teach girls how to cook, clean, walk, talk, etc. In this teaching method, nothing is written, everything has to be shown by the teacher and practiced by the teacher and the student together. The process will go over and over until the learner feels confident in him or herself.

Knowledge is acquired in a very different way than skills. It is taught by narration. At night, the men gather around the fire with the young boys of the village to teach them the Koran. The fire is used as light and heat in cold weather. Young girls are being told stories by the grandmothers. These stories represent lessons on cultural values. For example, what will happen to someone who does not carry out his duty such as helping his parents or older persons, paying respect to them, not stealing, not lying, being faithful to friendship, being grateful, forgiving and helpful, and so on. Such a sinner will be caught by the devil and will turn out very poorly. This can scare the child who will be frightened and haunted by this myth.

In Senegal, people <u>believe</u> in fate. If something is wrong, if they suffer from something, that is the way it should be; it is their destiny, God has decided their fate and it is believed that an individual will go to Heaven in another world if he or she accepts this decision.

Senegalese people believe in the family nucleus and in friendship. For them, thinking out loud about themselves is being selfish. They share everything they think is worth sharing such as food , shelter, money, joy and sorrow. Ideas are shared but they don't evolve.

They respect older persons and are obedient to the suggestions of the elderly. A popular saying in Senegal and in Africa is "*A dying old person is equivalent to a burning library.*" This illustrates the fact that the elderly retain the power of knowledge, they do not share it with others besides the receipes they give. The old people die with their knowledge, perhaps telling the rules to one of the sons who will apply them in his father's way.

Narration is the teaching method. No proof is necessary. Rules are followed unquestioningly. Doubt makes them susceptible to the devil's power. Thus, there is little awareness of the cause-effect relation between rules and results. Everything is based on belief.

This belief goes so far that technology is often considered to be Western magic, a gift from God to the Westerners. On the other hand, Senegalese people recognize that education can change people. For instance, highly educated people who are acting like Westerners, denying their cultural values, are addressed with irony and sometimes with disgust as "Tubab", meaning White. From this, one could anticipate that this belief would badly affect the educational use of modern technology in Senegal because, in people's minds,

technology is linked to Western societies and for them learning how to use it can lead to a denial of their culture. But the following experiments do not support that anticipation.

Senegal has two kinds of schools and a literacy program.

1) The Koranic school system

The Koranic school was historically the first one in Senegal and came from the Islamic tradition. This system follows the same narrative teaching style described earlier, which is based on recitations, rote learning without questioning. Moslem children attend courses from about the age of four or five years. Although it is supposed to "open" the children's mind, to prepare the children to get ready for further learning, students are fed sentences they often don't understand. Prayers have to be said in a certain way to get a certain result. The process is mechanical. Few people go further than recitation; few learn how to read and write and discuss Islamic concepts.

However, what is important to notice at this level is that the good impact of learning is explained as a religious miracle; "the Koran opens the children's mind". Moslem children who go to Koranic schools before the French one are supposed to be more clever and get better results than those who don't. The discipline and humility of Koranic teaching is said to be the major factor.

2) The French school system

More recently, since the French colonization, the Senegalese have adopted the French school system which is completely foreign to their culture in content, but in its learning style, it fits what Paolo Freire calls "banking education" in which students are fed knowledge by teachers. Students passively receive information instead of engaging in a dialogue. Some Teachers even deliberately undermine the students' value and self-image: education requires learning to accept authority.

2.5.2 The language issue

Although there are several native languages which are now written, because of the colonizaton, Senegalese schools still use French teaching materials, from books to other technology tools. What are the attributes of learning in French or in native languages? I can see positive and negative aspects in both of them:

Learning in French is positive because French is a language of industrial development which allows to have access to litterature and scientific ideas and to extend literary, mental and social boundaries.

Its negative aspects are psychological. It is the language of the masters and is associated with stratefication concepts, therefore changes Senegalese culture by restraining the development of emotional relationships.

Learning in Wolof as a native language does not promote class distinction

only levels of thought. The genius of the people can express themselves more easily. It promotes self-sufficiency.

However, there is a problem of translating existing scientific data into native languages. This will take time and hard work, and Senegalese people will not be developing appropriate ideas, instead they will be imitating while science and technology progress.

The present reality in Senegal is that French is considered as the only linguistic means of social promotion. It is the instrument to learn everything else at school. Attempts to introduce technological tools to improve the French teaching methods have been made through different projects under the Ministry of Education with the main ones undertaken by the Center of Applied Linguistics of Dakar. The first method called CLAD, well known for its failure, was introduced in 1969-70.

In the CLAD method, the radio is used to teach French in primary schools. The teacher will place some characters' pictures on a special board, the radio will emit sentences representing a dialogue and the children will repeat the sentences to play the characters' different roles. This method failed in its second phase when the Ministry of Education in 1971 decided to spread it throughout 2250 schools. The teachers were not ready to use it because they were not trained enough to make it their own, nor were they involved in the decision making. The method was imposed on them. Consequently, they

responded with hostility. Teachers made it fail by criticizing it wherever and whenever they could. The results were very poor and the students' parents, informed about the causes of their children's failure as being linked to the CLAD method, supported the teachers' union in their struggle to drop the method. The union won and the radio was eliminated from schools.

The latest method is the use of television to teach children in their native language, Wolof. This started in 1978-79 with 10 experimental classes, representing 0.5 per cent of the total number of classes in Senegalese public schools. There were 4 in Dakar to teach 489 children, 4 in Thies, 1 in Diourbel and 1 in Saint-Louis. By 1983-84, the number of children in the Dakar classes decreased to 453. They took two national exams in French. One is a competition for a place in high school. Only eight per cent of them passed. The other exam is to get a diploma for graduation from elementary school. Only 22 per cent have succeeded in doing that. Many Parents who allowed their children to go through this Wolof teaching at the beginning were disappointed by their children's results and withdrew them. In the year, 1984-85, all the children remaining in the experiment were dispatched to different schools in Dakar.

The literacy program

Following the UNESCO meeting at Teheran in September 1965, in which Ministers of Education gathered, Senegal decided to start a work-oriented

literacy program, using native languages. Studies on the Senegalese milieu in economics and sociology resulted in a feasibility proposal to raise funds and collect data on languages being used in the regional training centers. It is reported that in 1979, 3 million Senegalese (more than 50%) were illiterate. The following table represents the recent statistics.

Regions	1982-83		1983-84		Languages
	centers	students	centers	students	
Cap-Vert	16	884	17	598	French,Wolof, Pulaar,Seereer
Thies	45	1,225	19	636	Wolof, Seereer
Louga	1	6	6	100	Wolof
Fleuve	29	275	9	276	Wolof
Senegal Oriental	19	428	62	1,390	Wolof, Manding Seereer,Pulaar
Casamance	34	1,193	84	3,103	Pulaar,Manding
Diourbel	36	1,255			Wolof
Sine-Saloum	29	1,153	28	1,224	Wolof, seereer
TOTAL	209	6,419	225	7,327	

NOTE: The alphabet used to write these native languages derives from the Latin alphabet, except that some letter sounds are different; for example : C, J, X, H. There are no sounds Z, SH, V, but compound letters like MB, ND, NG, NJ, NK. Here is the alphabet list : A, B, C, D, E, F, G, H, I, J, K, L, M, N, n, n, O, o, P, Q, R, S, T, U, W, X, Y, Y, MB, ND, NG, NJ, NK.

The table reflects the current activities of the literacy campaign. Only three centers in Dakar are using French to teach a total of 118 people. We can notice that the number of centers and students are varying. The number of centers in some regions (Thies, Fleuve, Sine-Saloum) is decreasing. In 1979, there were 12,000 illiterate adults registered as students and about 50% dropped out. The program is not working well. Although no serious studies have been carried out to ascertain the reasons for this, two factors seem obvious.

First, the project has been arbitrarily imposed. The teaching methods and the actual literacy program offer people the opportunity to learn but do not take into account the social environment. The system comes primarily from the top. It is the government which decides which native languages to be used, the teaching schedule and the location of the learning centers. In other words, the government decides what, when, and where people should learn through the use of the television, the radio, and the newspapers. The program is not based on a rational analysis of how and why learning should happen.

Second, it contradicts the natural developments going on in the country. In Senegal, everything but some recent low level literacy books and some revolutionary newspapers is in French. French schools are the only ones leading to an enviable career, therefore everyone who can, sends his or her children to a French school. The news, the road signs, the governmental reports and most of the conferences, are in French. Thus, the illiterate adults

in Dakar, are unknowingly alienated from the world beyond their immediate community. Learning in another language than French will not integrate them more into the current society of literacy.

Reactions to this literacy program have been complex and raise two principle points of view. Some people believe that French is a link to Western scientific developments which can be helpful to the country's development. Others believe in the preservation and development of local culture which is reflected in the interest in developing literacy in regional languages. Both positions seem to be valid but for different reasons, although they both carry negative aspects.

A successful literacy program in Senegal will require a concept which mediates between these points of view. The computer is a neutral medium, a tool which may serve this mediating role. Its use is not directed to one specific matter since it is flexible and adaptable to a given purpose. The following section addresses the epistemological issue that can be raised by the use of computers in Senegalese education.

2.5.3 The epistemological issue

In Senegal, ideas are "objects" one inherits from one's ancestors. Thus, they are not discussed with the intention of changing them. Thus, ideas do not evolve. Similarily, culture is something static which is to be preserved. It is difficult to separate that which is worth preserving and that which is an obstacle to happiness and social progress. Therefore, there is no active

thinking about the world, no transformation of the world or the self. Since parents did not think of changing the world, how would their children think of doing so?

The two educational systems, the Koranic and the French both have components of educational practice which support narration and memorization without debate. Belief in narration does not stimulate dialogue, discussion of ideas, critical thinking about the self or the environment. It does not raise consciousness about cause-effect relationships; effects are noticed and believed to come from a superior and unchallengeable force, God the supreme. Again, issues of faith are not separated from issues relating to human reason and self determination.

This unawareness about cause-effect relationships may explain why some people are not eager to do such work as assembling a kit to build a tool. Constructing a mechanical tool from a set of parts, a bicycle for instance, requires following and combining instructions. People would rather stay away from these exercises and pay a specialist to do the job for them.

Programming with the computer language Logo is different from assembling a kit to build a bicycle for the following reasons. First, the kit is conceived by someone else and there is only one way to assemble it which is the one defined by the constructor. Not achieving the assembling in a right way may cause frustration because you don't fulfill your expectation. The only

operations you can do are based on concreteness, you build concrete blocks, put them together to create one thing and the different pieces have to stay together in the way the designer wants it.

In Logo, the user conceives his or her own "kit"; a programming project is of his or her own design, from his or her own initiative, the user can organize, change and debug it. And because the user has designed his or her own project, he or she will have emotional involvement and will investigate more. He or she gets answers from the system because Logo is an interactive language. Programming with Logo is a more abstract way of building blocks. Because Logo is a procedural language, one can create the component pieces (subprocedures) of a thing, move them around, correct the mistakes with fewer frustrations about "doing wrong things". Not only has the user the ability to debug his or her work but he or she also can use the same subprocedures in other projects.

Logo offers hope for a new notion of literacy in Senegal. It is a new piece of culture which the Senegalese can use to extend their own culture by appropriating pieces of scientific culture. It is free from the burden of tradition and carries with it new relationships to abstract thinking and ideas usually deficient in current educational practices. Before I turn to a discussion of Logo, I will address the introduction of contemporary technology into Senegal.

2.6 CURRENT STATUS OF COMPUTERS IN SENEGAL

Although current technology is not being introduced in the same way as the rail road, the success or failure of the computer as an instrument of constructive change in Senegal depends on the role played by the Senegalese in introducing it into Senegalese culture.

In the city, people are using technological tools like the television, radio, video tape recorders, cars,...One pushes the button and the television or the radio goes on. If the engine starts, it is fine , if not, he or she takes it to the engineer who will fix it. There is nothing wrong with this as long as the local engineers are employed. But if the foreign manufacturers don't teach indigenous people to understand how these tools work, there will not be any improvements on foreign tools and no means to adapt foreign technology to the needs of the Senegalese.

This problem is serious with technologies which are used passively. With a more aggressive technology like the computer, the need for cultural sensitivity is perhaps the dominant issue in determining ultimate success.

In the past, there were no preliminary cultural studies, therefore, no intelligent training before introducing new technology. As a result Third World people who found their actual needs completely linked to the machine could not design a new technological tool or even fix an old one. They became dependent on the developed nations' knowledge. While the Senegalese learn

how to use the machines sold and sent to them by the developed countries, these developed countries are creating other tools more sophisticated, complex, and efficient for their own use. Thus, the vicious circle continues, and the gap between poor and rich countries widens further.

Since 1976, in an attempt to avoid this vicious spiral and other mistakes of the industrial revolution, the Senegalese government has been developing computer science projects as a research field for the following reasons :

1) Computers are being increasingly used in the world and in a wide variety of areas such as industry, administration, business management, documentation, education, leisure and so forth.

2) Not only are computers widely used in different domains but they are known to improve the efficiency of a system if they are adequately applied. For example, computers make it easier to store huge amounts of information and to be able to extract or update all or a piece of it in a short time.

3) People fear being invaded by this new tool without knowing how to use it in suitable and profitable ways. When a tool is applied without taking into account the environment, it can produce unexpected results. The Senegalese want to control (and not be controlled by) the introduction of this technology.

The Senegalese government installed a computer at the Science Department of the University of Dakar in 1976.

The first use of the computer was to allow researchers to process their scientific data automatically.

Later, the Ministry of Scientific and Technical Research created a computer laboratory for agricultural research with a central IBM computer 3741 linked to five IBM terminals 5120 installed in remote research centers located in different towns. The objectives of such a decision were to establish a network between researchers in agriculture so that they could share their results in a more efficient way. They would avoid duplication of research and save time to do further research.

The same Ministry has a computerized center of scientific documentation. I was appointed by this Ministry to create three data bases for researchers. One is built with bibliographic references of books written about Senegal and/or by Senegalese authors. Another one concerns scientific magazines received in Senegal. The third one contains information about the Senegalese documentation centers.

The latest project of this Ministry, the Research Institute of Applied Mathematics and Computation, illustrates a general interest in some of the issues I am addressing. This is reflected in its aims listed below.

1) The promotion of the use of mathematics for the country's development;

2) The promotion of the exchange of knowledge; and

3) The mastery and adaptation of computers to the Senegalese environment and culture through the creation of appropriate software and hardware by Senegalese people.

Implementing these aims requires a great deal of probing. For example, how should mathematics be promoted? What are the obstacles which prevent the exchange of knowledge? What is appropriate software?

The first step of the Research Institute of Applied Mathematics and Computation is towards the use of computers in education. I was appointed by the Ministry of Scientific Research to lead the project "Computers in Education". This experience is the basis of my current research through which I will attempt to answer the questions raised earlier.

CHAPTER 3

THE "COMPUTERS IN EDUCATION" PROJECT

Why computers in education

One might try to use several different strategies for improving education in Senegal. However, the use of computers is imposed by the fact that Senegal, as a Third World country, has no choice but to become prepared for the computer culture which has begun to revolutionize the Western world. The first industrial revolution was a failure in Senegal because of the way in which technology was introduced into society. In order not to repeat this failure, we would like to investigate ways of adapting the computer to the social environment in which they will be used.

Twenty years ago, purchasing a computer was a big deal. There were mainframe computers at a very high cost, used to process repetitive information as periodicals, personnel payroll, statistical tables, bills and so forth. They were used to manage large files for big companies.

Now, with the wide range of micro computers and their performance and decreasing cost over the past twenty years, computer technology is more easily available. In developed countries, personal computers can be found in many homes. They are used to play games, to instruct people by displaying lessons or solutions to exercises, drill and practice teaching and so on.

3.1 FIELD WORK IN SCHOOLS

Computer science is considered to be a difficult subject which can be understood only by some mathematicians, "*very clever*" people. Although, there are easy ways of using the computer (see next section on Logo), it is very hard to convince many people to manipulate a computer. The "*mystery*" of computers needs to be unveiled. One way to do this is to let children manipulate and program them; adults would follow more easily afterwards. Because the computer is accessible to children, adults will understand that it can be simply operated.

In using computers with children, within the Senegalese research project "COMPUTERS IN EDUCATION", we are trying to find out what computers can bring to the learning process of Senegalese young school children, as stated in question 9 of the research questions.

We do not use the Computer Aided Instruction mode (C.A.I) which we felt would simply automate the already existing educational practices which have proven to be unsuccessful. We foresaw the difficulties of learning using the traditional practices such as narration and passive learning in which the student is fed by the teacher's lessons and takes the teacher as a whole model to copy. The C.A.I. software plays the traditonal teacher's role of teaching facts instead of skills. In the worst cases, the student will act like a machine which becomes the teacher. On top of that, are the social problems like the denial of Senegalese culture which certainly happens by purchasing existing

C.A.I. software, the notion of "intrusion of Western culture" which is aggravated through passive learning, the difficulties of appropriating technology because of its rigidity which makes the user a victim of the software designer and the whim of the machine.

We use Logo which is a procedural and interactive language in which children program the computer instead of being programmed; children themselves become software designers.

The research project "Computers in Education" focuses on the following points :

1) Acquaintance with the use of computers to facilitate their future integration.

2) Computer mastery by teachers and students.

3) Development of children's creativity.

4) Development of an adequate learning environment, efficient for both children and adults.

To achieve these goals, we are observing how young children from elementary schools of different social backgrounds use this new technological tool. We measure the influence of computer use on the children's learning in school. We will evaluate the results of the experiments in order to outline appropriate uses of computers in Senegalese education.

The evaluation of the project has three aspects :

1) The sociological one should answer the question "*how do children react to computers according to their social and economical backgrounds ?*".

2) The second about epistemology should clarify "*what and how can Senegalese children learn with computers ?*".

3) The third aspect is related to psychology and pedagogy, but is concerned with policy. It should give an answer to the question "*how could computers be introduced in Senegalese schools ?*"

3.1.1 Why Logo?

Logo was developed by Professor Seymour Papert and his colleagues at the Massachusetts Institute of Technology. Under the name Logo, there are two ideas: first, Logo as a philosophy of education and second, Logo as a computer language.

Logo is a philosophy of education taking its roots from Artificial Intelligence and Piaget's work about genetic epistemology. It is based on the fact that a rich learning environment can provide effective learning and that giving people personal control over powerful computational means can allow them to be in contact with scientific and artistic ideas.

It is a computer language flexible enough to be easily manipulable by children and beginners. It is a procedural language in which programs are created by combining instructions. A program is a set of commands. It can be a simple procedure or a more complex one, combining different simple procedures. Logo is interactive; the primitive commands and the user's procedures are executed directly. Procedures can be created, modified through the editor or deleted.

Logo provides an "object-to-think-with" which is the turtle. The turtle is a computer-controled abstract animal on the screen, it can be guided by the Logo commands to move forward, backward, to turn right or left, to appear or disappear on the screen. Using Logo procedures, one can draw geometrical

figures on the screen.

Why can Logo be appropriate for Senegalese style?

The principal commonality between Logo and Senegalese teaching style is the basic strategy which is founded on building upon epistemological strengths.

The Logo philosophy is based on a three-way dialogue, a continuous interaction between teacher, student and the computer to find ways of solving tasks. Teachers and students are collaborators. In Senegalese teaching of skills, I mentioned that the teacher who is a member of the extended family, teaches by showing and practicing with the student. In Logo, learning happens by doing, practicing with the teacher. Thus, the two learning styles have *learning by doing* in common.

On the other hand, Senegalese teaching of knowledge is mainly based on rote learning which I believe is not a suitable way of promoting critical thinking. Rote learning is not a suprising consequence of Senegal's oral tradition. But, when it is combined with the authority of the "writing" teacher, the notion of dialogue is completely eliminated. Programming in Logo, on the hand, increases the avenues for dialogue and provides intellectual rigor to that dialogue. We will see in the Senegalese research project what strategiies the Logo philosophy allows teachers to use to counteract the tendancy to rote learning.

Mathematical ideas can be experienced on the "doing side" of the barrier between learning of skills and learning of knowledge. Logo can be used to handle mathematical concepts by doing. As Dr. Papert described in Mindstorms, it can help the learner build intellectual structures.

In Logo, everyone has his own way of tackling a problem, programming a project. For instance, a square can be drawn in several ways:

```
1-  TO SQUARE1
    REPEAT 4 [FORWARD 50 RIGHT 90]
    END

2-  TO SQUARE2
    REPEAT 4 [FORWARD 50 LEFT 90]
    END

3-  TO SQUARE3
    REPEAT 4 [FORWARD 50 RIGHT 50 RIGHT 20 RIGHT 20]
    END

4-  TO SQUARE4
    FORWARD 50
    RIGHT 90
    SQUARE4
    END

5-  TO SQUARE5
    REPEAT 4 [FORWARD 25 RIGHT 90 FORWARD 25]
    END

6-  TO SQUARE6
    REPEAT 4 [RIGHT 45 FORWARD 50 RIGHT 45]
    END

7-  TO SQUARE7
    SETXY [0 0]
    SETXY [0 50] SETXY [50 50]
    SETXY [50 0] SETXY [0 0]
    END
```

and so on. The third possibility is more of a child's way of finding the right

angle.

Doing this research with the Logo computer language allows us to create a stimulating learning environment in which it is possible to learn in a creative way. People learn together. The students do not feel dominatd by the teacher. They think about what they want to learn, how they want to learn it, and are able to discuss their ideas freely. They are not threatened by the fear of failure. They learn to value mistakes as a vehicle for intellectual development and can thus learn in a self-confident manner.

3.1.2 History of the project

1) Preliminary training

In December 1981, the Senegalese Minister of Scientific and Technical Research, Dr. Jacques Diouf, decided to send a Senegalese team to New York to study Logo. The team was comprised of two elementary school teachers, one child-psychologist, one mathematician, one sociologist, and me, as a computer scientist. The Minister had heard about Logo and chose it because our team wanted an interactive computer language that can catalyze abstract thinking, unveil the cause-affect relationship between things, and flexible enough to allow its integration into different cultures. The objectives of the project justify the diversity of the disciplines represented in this team.

The team went to New York in January 1982 for one month of training in Logo. The first day, we were introduced to Logo by Dr. Seymour Papert. The roots

and the aims of Logo were explained to us, demonstrations of some fascinating programs were made. We wondered how young children could produce such results.

From the following day on, we started programming the computers. Although I was the only one who had used a computer before, everyone seemed to understand how to use the basic commands and progressed from there. The environment was rich in computers and teachers; and sometimes, children would come and work with us.

We had the opportunity to visit three of the nine New York schools which were using LOGO at that time. We saw that the computers were set in the conventional class room and the children who wanted to, were using them by turn. We learned from the CLAD method mentioned in the previous chapter that initiating the same program in Dakar without preliminary research on the efficiency of computers in education, could result again in failure. This led us to think of another way to introduce the computer and LOGO in Senegal.

We were very excited about the idea of conducting the future research and we started discussing ways of doing it. The wisest solution we found was to start with a separate research lab, outside the school. Then, we would progress further. We went back with this excitement and these ideas and two computers to start with.

In March 1982, the project was launched and its laboratory opened in the

research center of ECOLE NORMALE SUPERIEURE DE DAKAR. As a result of an agreement between the Senegalese government and the World Center for Computation and Human Resource in Paris, the laboratory received from Paris six micro-computers with monitors, disc drives, Logo and blank discs and four printers. The project team had acquired basic knowledge of maintenance for the computers they would use.

2) The experiments

The team described earlier worked in the project as LOGO teachers and observers. Because of the lack of a free classroom in these schools to carry out the experiments, we set up the laboratory in the research center of "Ecole Normale Superieure". But the laboratory was related to the schools. The principal of each school functioned as a coordinator informing the children's parents and scheduling work periods. A shuttle van was always ready for the transportation of the children back and forth between their school and the laboratory.

The design of the experiment allows its results to elucidate the research questions of section 1.2. The initial sample of 18 children were distributed as follows to obtain a mix of cultural background, sex and school performance.

We started working with a small group of 18 children who were between 8 and 11 years old, selected from 3 different elementary schools. 6 children were from a school called "Franco-Senegalaise", 6 from "zone B" and 6 from

"Dieuppeul".

Franco-Senegalaise is located in a residential area and is frequented by upper-middle class children. It is a mixed school where 50 percent of the children are Senegalese, and 50 percent non-Senegalese (French and Belgian mainly).

Zone-B is located between a upper-middle class neighbourhood (Cite Zone-B) and a very poor neighbourhood (Fass-paillote). It is frequented by children from the middle, poor, or very poor classes.

Dieuppeul is situated in a middle class neighbourhood and the children are from this same area.

Each group of six-children was composed of three boys and three girls of different ages and different classes. Two in each group had high school scores, two were average and two poor.

From March to June 1982, the children worked in teams of two on a computer for two sessions of one and a half hours a week. On Wednesdays, each child had his or her own computer. We showed the chidren how to start the computer and taught them how to use some basic Logo instructions in French for the Logo turtle moves: AVANCE (FORWARD), RECULE (BACKWARD), DROITE (RIGHT), GAUCHE (LEFT), and so forth.

Then, we let them start programming the computers by giving commands to

the turtle. Children conceived their own graphics projects. They succeeded in drawing masks, houses, horses, planes, Senegalese cookware, and so on. We kept on observing them, helping them by discussing their projects with them, and introducing new Logo concepts when needed. The researchers met every day, to talk about our observations and suggestions.

3.1.3 Observations

The kinds of observations we made are best shown by a description of one of the eighteen students.

PENDA'S CASE

1- Background

Penda was a eleven-year old girl, from Zone-B. She was an excellent six-grade student. Her former teacher is involved in the project; he chose her to participate in the experiment. Although her parents were informed about that, they did not show any interest in their child's work. They never showed up in the laboratory to know about their daughter's activities, whereas other parents from different upper class families did. She was from a low-middle class family and she had never had an electrical or electronic toy.

2- Results and Discussion

In the first sessions, Penda lagged behind the others. One could notice how careful she was in front of the new tool. Perhaps she was feeling a kind of

frustration because, in the conventional class, she was always the queen. She was very slow. During the first sessions in which she had to work with another child on one computer, she was staying behind the other who was typing some Logo commands on the keyboard. She was either afraid of asking questions, or she did not have any questions to ask, or she was just confused. A change came on Wednesday sessions, in which each child had the opportunity to work alone on one computer.

The first Wednesday, Penda started to touch the keyboard and play with the commands : AV, DR, GA, VE. She tried to redraw the pictures the others were drawing during the three first sessions, such as squares. Then, she wanted to know how to save her picture in the computer memory; as she did not dare to ask us, she asked to the other children who showed her. She built 4 square procedures of different sizes and saved them in a disk.

The next session, she was working with another boy Ibrahima who was her age and from the same school. He was a brillant student too. But Penda did not want him to touch the keyboard because she had so many ideas in mind to test. It was as if she wanted to catch up and to take her revenge over Ibrahima who was doing better than her during the first sessions. She built a procedure called CARRES assembling all the squares of different sizes like this:

```
POUR CARRES
CARRE1
CARRE2
CARRE2
CARRE4
FIN
```

When she executed the procedure, the picture she obtained was like this :

```
 _____
|                     |
|  _____     |
|  |           |      |
|  _____   |      |
| |        |   |      |
| _____    |   |      |
| |   |    |   |      |
| |   |    |   |      |
|_____|
```
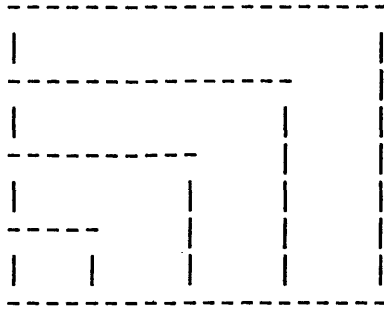
She was amazed and showed it to the others who asked her how to do it. She then, went to Fatou's computer to show her what she did. But, they made a mistake in typing the last procedure like this:

```
POUR CARRES
CARRE1
CARRE2
CARRE3
CARRES
FIN
```

A picture of only three squares appeared on the screen and the turtle kept drawing the same picture again and again. There was a bug but they liked it and watched it for a while before Penda turned her head toward us, one hand on the mouth, to request help. I came and she asked how to stop it (so that they would regain the control). I showed them how to do it by using the command "CTRL-G". They went back to the procedure CARRES and looked at it carefully and found out the mistake. They corrected it, ran the procedure again and got the expected picture of 4 squares. But the bug created something else because, Penda went back to her computer and tried to reconstruct the bug. She played for the rest of the session in creating the

same kinds of recursive procedures and using CTRL-G to stop the execution. After that, she saved everything and that was the end of the session.

The following Wednesday, she came with other ideas; but what had fascinated me the most was that she had never prepared her drawing on a piece of paper as many of the others were doing before typing her procedures. She was going from one step to another, each more sophisticated than the one that preceeded it, by staring at the screen, initiating new ideas and adjusting her designs. She would get stuck sometimes and ask for help; this was the occasion for us to introduce new Logo concepts. For example, the notion of inputs or variable parameters was introduced to them when Penda raised the desire of making only one procedure CARRE that can be used to draw squares of different sizes. We considered the four procedures CARRE1 CARRE2 CARRE3 CARRE4 she had made and looked at the differences. Penda noticed that only the value after AV (FORWARD) was changing and we called that value PAS (turtle's step); we explained how to attach that value to the procedure so that it could be changed at each execution without changing the procedure itself. We wrote CARRE :PAS in the definition like this :

```
POUR CARRE :PAS
REPETE 4 [AV :PAS DR 90]
FIN
```

and CARRE 50 at the execution of a square of size 50.

Penda played a lot with these kinds of procedures, building triangles, arcs,

rectangles, circles, stars, fish, houses, etc. By the end of the third month, she had made 52 procedures!

Thus, little by little, she was gaining confidence in herself, building very complicated procedures resulting in fine representations of African masks that amazed all of us. Here is the complex procedure MASK with its components:

```
POUR MASK
SANNE FLEUR VANNE
FIN

POUR SANNE
REPETE 60 [FCC 4 TRIANGLE 40 GA 5]
FCC 5 TRIANGLE 40
FIN

POUR FLEUR
REPETE 36 [CARRE 50 DR 10]
FIN

POUR VANNE
REPETE 20 [POISSON GA 5 POISSON]
FIN

POUR POISSON
FCC 5
PETALE GA 90 TRIANGLE 90 CT
FIN

POUR PETALE
ARC 10 DR 90 ARC 10
FIN

POUR ARC :PAS REPETE 9 [AV :PAS DR 10] FIN
```

```
POUR TRIANGLE :PAS
FCC 2 REPETE 3 [AV :PAS DR 120] FIN
```

Changing the pen colors in the subprocedures SANNE, POISSON and TRIANGLE, resulted in a colorful mask. The following picture is the drawing of the procedure MASK in black and white, though this is a very inadequate impression of how it appears in full color.
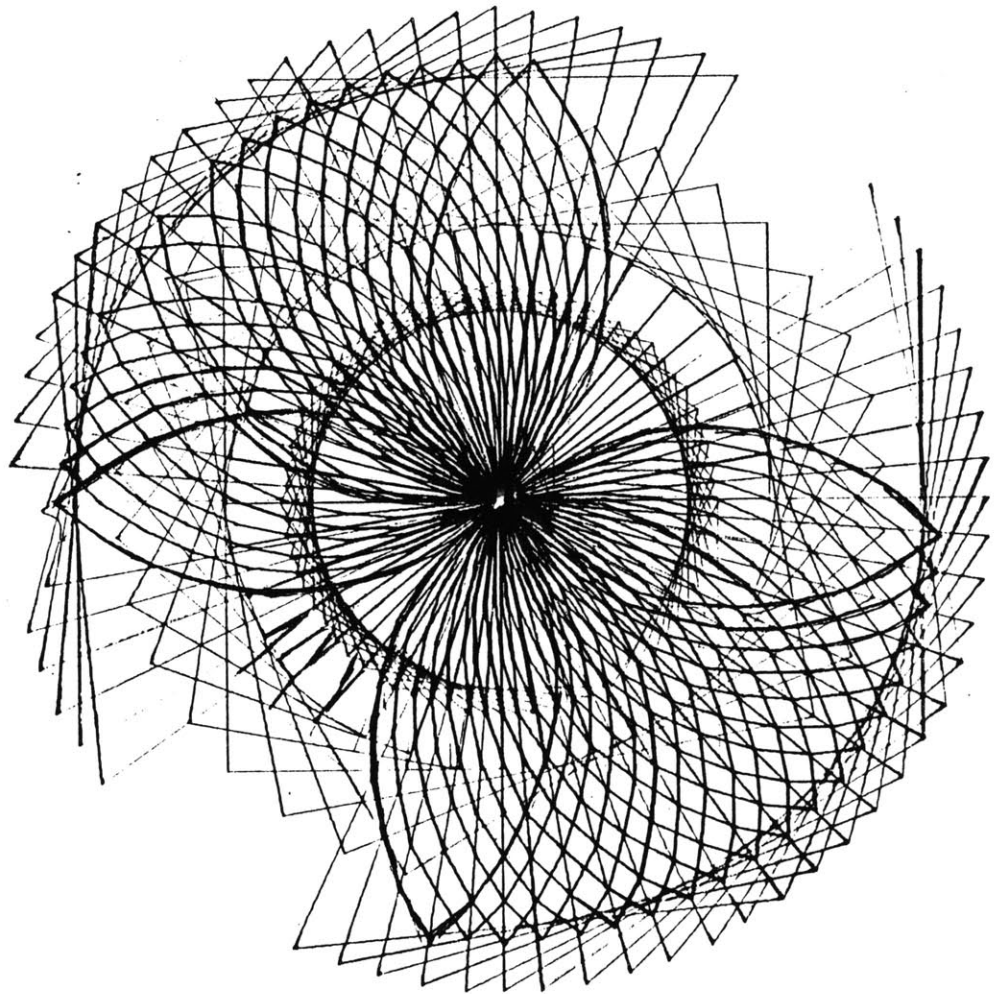
Penda's computer experience affected her social life. She developed an excellent team relationship with Fatou, a girl whose parents are wealthier and more educated than hers. This working relationship which was cemented by their enjoyment of doing good work together, perhaps because they were much more successful than the boys, developed into a close friendship that has continued beyond the computer collaboration.

COMPARAISON BETWEEN GROUPS OF STUDENTS

1. THE ZONE-B STUDENTS

The children from Zone-B who were very shy at the beginning changed their attitude towards the researchers. One of the researchers was a teacher at Zone-B, and we thought that because of that, the children who knew him as an authority figure might feel themselves in a new kind of conventional school. When we asked them "what is a computer for you ?" they said "It is *something* I can learn with". To the question "Is it a toy or something serious ?", they answered "It is something serious".

Thus, we observed problems and developed strategies for counteracting them, and this led to good results.

Initial problems

Initially, children thought that this must be serious because otherwise, the teacher they knew would not be there. They did not dare discuss their projects aloud, fearing that they would be heard by the teacher and be punished. They were keeping an eye on us while mumbling their theories.

Counteracting the problems

We had to reassure children that this was a different school, there was no punishment, they should be relaxed and just take this experience as a game.

Strategies

We (teachers and students) were calling each other by our first name to counteract authoritarian attitudes. To deter rote learning habits, we asked them to explain to us how they succeeded in drawing a picture on the screen even if it was something not extraordinary for us. These exercises in describing improved the students' command over their thoughts and facilitated their ability to move forward. We worked with that philosophy and it started to succeed in a short time (three weeks).

Results

Children were starting the machines, booting the LOGO disk themselves. They were talking between themselves, about their projects even if the researchers were around. Sometimes, one of them got up to play the turtle to convince him or herself and the other children of the correctness of his or her reasoning. Children were more and more releasing themselves from the possible pressure of our presence.

2. THE FRANCO-SENEGALESE STUDENTS

We noticed that the six children from the Franco-Senegalaise school district took to the keyboard more easily than others. This school's children were use to having all kinds of toys. They would play with, destroy them and get others. Some of the children had traveled to many countries and saw many kinds of toys. Two of them owned a personal computer at home. When we asked them what a computer was for them, even if they did not know about it before, they would say "it is a toy". For this reason, they were not afraid to manipulate the computer keyboard. They were working faster and creating richer designs than the others. They had another style of drawing and the subjects of their drawings reflected their exposure to modern technologies. For example, they were designing planes, cars, war jets, and other modern tools whereas the other students were drawing masks, cookware, African houses, horses, and so on.

Initial problems

After three weeks, the Franco-Senegalaise students seemed to be tired of this new toy. They became less involved than the others.

Counteracting the problem

It was obvious that they needed something new. They were ahead at the beginning because they found it more familiar, more toy-like. Once the

superficial similarities were exhausted, the differences between the computer and other toys needed to be articualted for them. Understanding this, we tried to provide them with new challenges.

Strategies

We did other demonstrations with turtle geometry and simple animation procedures with Sprites which are motion turtles. We also built procedures for arithmetic operations and verb conjugations.

Result

This awakened another interest. The students started working on more complex projects involving more thinking such as drawing traffic lights and building a kind of small data base with names. From that point, we did not have to push them anymore. They were progressing alone. One of them, Fifi, said to me one day "this is a game but at the same time, I am learning with it". When I asked her to tell me what she was learning from that, she replied "a lot of things. I understand more about geometry, the circle and the arcs. I am typing like adults. I feel bigger than I am."

In general, children became less shy and gained confidence in themselves. They became acquainted with the keyboard within a few weeks. They were all conceiving their own projects, and analyzed them before building the programs to draw their designs. They all seemed interested in what they were

doing, and were so absorbed that we often had to interrupt them when their time was up.

3. GENDER DIFFERENCES

In the United States it is reported that girls are more reticent with technical matters. For example, in the High Density Project of Boston in which each student has his own computer, teachers reported that boys, on the whole, became more interested in and apt to use the computer.

However, quite contrary to the Western case, our study in Senegal found that it was the girls rather than the boys, who were far more involved in using the computer. The pictures and procedures that the girls created were far more complex than those created by the boys. Even though boys and girls shared their ideas, it was most common to see girls show boys how to write programs to draw complex pictures rather than the other way around.

The phenomenon characterized by the girls', rather than the boys, creating greater, more complex and apparently more creative procedures requires explanation. I offer a first attempt in terms of ideas the psychologist Sherry Turkle describes in her book The Second Self - Computers and the human spirit. She distinguishes between two problems of learning: "hard mastery" and "soft mastery". Hard mastery is defined as "the mastery of the planner, the engineer" which calls for more abstraction. Soft mastery is described as "the mastery of the artist", it is more interactive and more related to concreteness and to the notion of "bricolage" (tinkering).

Logo allows both hard masters and soft masters to express themselves. But, I

believe that certain predispositions make it easier for somebody to be more or less inclined to be a hard master and/or a soft master.

In Senegal, the lives of women predispose them to becoming "bricoleurs" in their life activities. For instance, cooking is taught to them not by recipes but by practice; they will put some ingredients together, cook them, taste for salt, add some other ingredients. Sewing is also done by the same process. They will sew one part, try it and add something else. Just like any piece of art, women's daily activities require observation and spontaneously adding something new to enhance the appearance of the thing being processed. There is no fixed and predefined pattern at the beginning.

On the other hand, boys are trained to carry out functional tasks which do not require artistic skills. For example, ploughing a field does not necessarily require creative imagination.

Thus, I think girls are more prepared to take spontaneous decisions when they are given the opportunity.

Going to school gives children (boys and girls) the opportunity to deal with some abstraction, to be hard masters.

Consequently, when we consider two excellent students of different sexes, from the same class, as Penda and Ibrahima, it is likely that in a Senegalese Logo class, the girl might have more advantages than the boy in creating more

and more complex pictures.

Of course, another factor which we cannot discount is the presentation of the material and the environment created by the instructor. As a woman, I may have emphasized the soft mastery (though as a computer scientist, I did not discourage hard mastery). The fact that many computer teachers in the U.S. are also women tends to diminish the importance of this counterargument.

Although there were differences, this does not imply competition among the children, they knew that they were not graded; instead, they were working together. Each was proud to find something new and to explain it to the teacher or to another child. *The best student in the conventional class was not always the best in creating complex procedures in Logo.* He or she could even be taught something new by the weakest student who became more self-confident. For example, Nguilane, another girl from Zone-B was not doing as well at school as Ibrahima a boy who is in the same class as she is. But she was far more creative than him and she was teaching him how to build a complex procedure from a simple one. There were two procedures : CARRE and NAPPE. NAPPE was made by repeating many times [CARRE DROITE 10]. Here are the procedures:

```
POUR CARRE
REPETE 4 [AV 50 DR 90]
FIN

POUR NAPPE
REPETE 36 [CARRE DR 10]
FIN
```

With these ideas, Ibrahima was able to go to produce complex projects of his own. The fact that his own work improved made him willing to accept comments and criticisms from those (in this case, Nguilane) who were known to be under-achieving compared to him. Encouraging students to share their success with others made it unnecessary for them to be competitive.

DIVERSITY IN WHAT WAS LEARNED

Sometimes, children rediscovered geometrical designs with amazement because they had just realized why such a design should be done in a particular way. For example they discovered why they had to type DROITE 90 to make the turtle turn a right angle in drawing a square for instance. They had been taught that a right angle was equal to 90 degrees and they made the connection with the right turn.

Nguilane learned that she can be as or more successful than the best student of her class.

One girl, Coumba, was not interested in drawing at all but in writing sentences. We provided her the facility to do this using (the primitives PRINT and TYPE). Soon, she was composing letters to her parents or friends.

Another 8-year-old girl, Fatou Diouf, could not read and spell even simple words but her reading and spelling improved when she was learning to create procedures. She would create a procedure CARRE spelled correctly because we helped her. When she tried to run the procedure with a different spelling, CARE, obviously incorrect, the computer would say "I don't know how to CARE". We would explain why the computer was not able to run her procedure and she would correct the spelling. We did not have to show her the spelling of CARRE anymore.

OBSERVATIONS ON RESEARCH QUESTIONS 9 and 10

- ### What happened in Logo class

Communication between teachers and children

Teachers developed new teaching strategies. They created several Logo programs for their own training. They were sharing their ideas through the programs they were creating. They were asking questions to each other, using each other's procedures to build new ones. Their main concern was to provide children ways of interesting them in learning. Logo Teachers were constantly thinking about what and how computers could contribute something positive to Senegalese education.

They were no longer conventional teachers like the ones these children knew in their school, but "friends" who work together. Children, once released from the pressure of the "teacher's eyes", were participating more in the Logo class discussions. For example, playing turtle was something quite spontaneous for them when they wanted to think about how the turtle would draw a specific project. They would get up and imitate the turtle with their feet.

Children were also sharing ideas among themselves and with the teachers, by asking questions to each other when they saw something they didn't understand or discussing projects they had difficulty with. From the teachers who would ask them with amazement how such and such projects were made,

children learned to ask questions to their classmates and teachers. Sharing knowledge became natural and children felt confident in formulating their questions.

What was learned

Drawing geometrical figures, children re-discovered notions they had been taught in class and understood them more deeply. For instance, the notion of right angle (mentioned earlier) was explored with the turtle's turns RIGHT or LEFT. They learned new notions like the outside angle when they were drawing a triangle. Notice the 120 degree angle (instead of 60) in the Logo definition of a triangle: REPEAT 3 [FORWARD 50 RIGHT 120]. The inside angle of the triangle was what was known to the children and it looked very small, smaller than 120. It was striking for them to discover this number by turning the turtle little by little. We made them see that the turtle was not turning around the interior angle of the triangle but the exterior one.

- <u>What happened back in school</u>

Teachers' impressions

A questionnaire about the children's behaviour at school, before and after using Logo, was sent to each school principal for use in evaluation. The results showed that more than 80 percent of the children were participating in the class activities more than before. For about 10 percent, this process went

so far that children were so excited in class that they were no longer listening to the teacher. 10 percent of the children did, however, remain shy at school.

School results

Incidently, all the children who had worked with us for four months before taking the national exam to attend high school, passed it. At least, one could not say that the hours spent in the lab disturbed these children in following the national curriculum, unlike what people believed about the CLAD method and the television teaching system mentioned earlier, in chapter 2.

CONCLUSION

From a sociological point of view, upper-middle classes children who are accustomed to having electronic toys, got acquainted with the computer more easily than lower class children. For the first ones, computers, at first sight, remind them of their toys; the latter take the computers more seriously as a learning tool. None the less, we noticed that with Logo, although initial contact with the computer is different from child to child, in the long run, all children have the same chance to succeed in expressing their style. Thus, this technology can be used in a adequate way by underpriviledged children.

Concerning the individual aspect, we have seen that girls are ahead in programming in Logo. This is completely different from what is going on in Western countries where boys are doing better than girls in Logo projects. In

the Senegalese project, by creating procedures, drawing pictures and playing turtle, children are rediscovering and understanding the mathematical concepts they had learned at school. They are sharing their knowledge by explaining to each other their specific work and progressing from there. Therefore, knowledge starts growing.

Finally, the psychological and pedagogical aspect regarding how computers should be introduced in Senegalese schools cannot be drawn without the teachers' action in defining clear possible Logo micro-worlds in which effective learning can take place. For instance, one of the main problems we are having concerns the teachers' training in Logo. Teachers must be able to capture the students' interest by always creating new strategies to enrich the environment. The example of the children from the Franco-Senegalaise school showed how fast students can get tired using the computer if they are not confronted with new challenges. But who challenges who? Growth must be mutual. Not only do teachers need to acquire new strategies for teaching, but also, children need to develop new styles of learning. Once teachers and students understand the possibilities of mutual growth, the freedoms and responsibilties of self-directed learning and the values of sharing knowledge, a Logo environment perpetually creates the seeds for new challenges. But it is the teacher who is in the position of nurturing the environment.

The most important point to be considered is that this is a research project which will have concrete social consequences. To reach our objectives, we

must investigate all possible factors that could enhance or interfere with the introduction of computers in Senegal.

At each research phase, we will hand in a report with recommendations, based on research results, to the government. The Senegalese authorities will then decide which place computers will have in the future educational system of Senegal.

3.2 <u>COMPUTERS</u> <u>AND</u> <u>ILLITERATE</u> <u>ADULTS</u>

OVERVIEW

In my study of how illiterate adults might respond to computer based learning experiences I worked with a group of women in Dakar and and another group in Dorchester, a section of Boston with a considerable population of immigrants from Spanish-speaking countries in South and central America. Although the conditions of the experiments were too different, and the samples too small, for rigorous comparisons they do suggest some conclusions.

I notice similarities between the two groups which seem to me related to the fact that they are women from Third World countries where social structures favor group interactions that I was able to exploit in designing the learning experiences. Not all approaches to adult education in the Third World make use of this source of strength.

I also notice some differences related to specific features of Senegal. Some might be surprising. One might think that the Hispanic women livng in Boston would be more used to computers and so less afraid of them. On the contrary, my Senegalese women took to computers more readily. I believe that this difference is real, is related to the observations on gender differences reported in the previous chapter and should be studied more carefully as part of the elaboration of strategies for the use of computers in my country.

3.2.1 Motivation of the Study

My field work on illiterate adults had two motivations, one derivative from observations made in working with children and the other an interest in adult education in itself.

The work with children sensitized me to the importance of the support children can get from parents who understand to some degree what their children are learning and who are themselves sensitive to educational values. The mother of one of the children in the "Franco-Senegalese" group came in one day asking to be able to work with the children to learn something about the computers. "My child is killing me with questions I cannot answer." She was not the only mother from this group to visit the project. But while, presumably, the children from other groups also bombarded their parents with questions about computers, none of these parents visited. These observations were the seeds of my interest in exploring how illiterate women could come to be interested enough in computers and to know enough about them to play a supportive role in their children's learning.

The other source of the interest was the question: could computers be used to give women brought up with traditional values a greater, or a different, interest in learning.

In the past, people learned that only the rich needed and could afford school education. Their living style created the need to be literate. For example, they

needed to write letters to communicate from long distances since there were no telephone at that time. Also, they had the time and the money to do this because they had people working for them. They would hire someone, usually from a religious institution to take care of their education. This was true in Western culture as well as in Senegalese culture. In Western societies, the teacher could come from a church. In Senegalese society in which Islam is the main religion, the teacher could come from the Koranic school, usually located in the mosque. Thus, knowledge was held either by religious or rich people.

Since the coming of technology the existence of industry has put economic pressure on people. The more they were educated, the less manual work they had to do and the more money they would earn. Thus, people became conscious of the value of education; middle and lower class people became more and more eager to study so they could raise their living style. There soon developed , as in Western societies, a vicious circle: a tendency for children with rich and educated parents to become even more priviledged; they can afford to go to good schools which are expensive and they have the support of their parents.

In Senegal there is hope that social structures can change the fact that children with educated or rich and supportive parents have more chance to succeed in learning. Indeed my own involvement with learning when I was a child, described in a postface shows a possible way of success among the

average Sengalese people. The extended family can serve as a support system for a child's education.

Another issue is that if there are public structures rich enough in stimulating tools, a child from an average Senegalese family can escape from illiteracy. In Senegal, public schools are available for any child. However, classes are so overcrowded and the environment so poor for learning, that children need substantial support at home to get results. One answer is to improve schools. Another is to create opportunities for learning in the home. Both issues need to be addressed in different ways. Literacy in the home is not the only way to insure literacy in the school. My own childhood illustrates that other social conditions can contribute to success (see postscript).

Again, because we are to live in a computer culture, children are taught to use computers in a profitable way for the reasons mentioned earlier. Therefore, parents or members of the extended family need to know about computers to support children. The following sections deal with different issues about computers and illiterate women as an example of adults using computers to learn.

3.2.2 Computers and Senegalese Illiterate Women

In the previous section I mentioned the importance of parental support in the growth of their children. This led to the study of illiterate parents which addresses, in general, the issue of how illiterate adults take to the computer. As more than 80% of the population in Senegal is Moslem, almost all men are more or less literate at least in the Koran. But it is easy to find illiterate women.

Composition of the group

From July-August 1984, I worked with five illiterate Senegalese women in Dakar: four married and one single (Elisabeth, 20).

Aida is a house wife, she is 52 and has 10 children all educated in French. She has a job at home consisting of selling pagnas hand-made by a weaver she hired. (A *pagna* is a wrap-around garment worn by a traditionally dressed woman.) She chooses the patterns, the colors and the type of material and estimates the cost and the sale price. Her husband is educated in Arabic.

Anta is 27 and has two girls who are going to French school. She is a seamstress and has her own store. She is also a tutor in this field and has approximately ten female students. She goes to other African countries with her girl friend who is educated in French to import fabrics for her business. Her husband is educated in French.

Ndeye is 24, she is a house wife and has a one-year old girl. She came to

Dakar two years ago from the village to join her husband. Her husband is her financial support. He is educated in Arabic; he migrated from his village because of the drought and is selling groceries in Dakar to make a living.

Ndiaya is a house wife, she is 22 and has one four-year old boy and one three-year old girl. Periodically, she goes to Anta's store to learn sewing. Financially, she relies on her husband. He is educated in French.

Elisabeth is 20, single and without children. She is working as a maid in the neighbours' houses. In Senegal, maids are treated like family. She works for this family, eats there and gets paid each month. She migrated from Casamance in South Senegal to earn a living during the dry season.

The work had three parts: a first interview, a learning experience and a second interview.

First interview

I made two interviews with each of them, one before and one after the learning seminars.

The first interview was designed partly to gather data and partly to stimulate awareness and the will to learn by offering these women an opportunity to learn Logo. The main topic of conversation was literacy and the questions I asked included: Can you sign your name when you go to the post office to cash a money order or do you have to pay someone to do it for you? Would

you like to be literate? Why? What do you know about computers?

Aida wanted to be literate to be able to read and write her own letters. She would like to understand what is in the press. She said she had always wanted to go to school but her parents never let her go.

Anta would like to be a better manager, know how to write and be able to read her customers' measurements, the bills and checks. She would like to be able to communicate easily with people from other countries. She also said that she wanted to follow her children's instruction and help them in their home-work.

Ndeye wanted to understand French, to read and write it. She thought she would be able to find a job in Dakar.

Ndiaya said she wanted to understand "what the educated people are talking about". She said jokingly and almost with disgust that she would like "to show off" by speaking French and working in an office. Then, she said "I want to be able to follow my children's future instruction".

Elisabeth's reason was to be able to read, write and speak French. Thus, she could write letters and find a better job.

The answers revealed that the group wanted to learn to overcome the difficulties they had in dealing with administrative matters. The women also thought that knowing how to read and write would provide them job

opportunities.

They preferred to learn in French instead of in Wolof which was their native language. When I asked them the reason, their responses were that they wanted to be able to communicate with their children who were taught in French to read the signs and understand them.

None of them have ever heard about computers before this study. Thus, this high technology had to be introduced rather smoothly and gently.

The Learning Experience

The main strategy was to go to these women and place the computer in a setting familiar to them. It was in the back yard of one of the women's houses where these women usually meet in the afternoon to talk after their daily house work. We were sitting on the ground or on low Senegalese stools. There was nothing formal.

We were using an Apple II E computer and Logo software. I introduced the computer and Logo to them by showing some graphic designs of different shapes and colors which interested them all and which Aida thought she could even use for her pagnas. Then I showed letters and numbers. They found the machine very similar to a typewriter with a television screen. I added "plus, here you control the television images by yourselves, typing on the keyboard". They seemed very excited and curious.

They decided to learn French. They wanted to learn how to write their names and spell them and how to make some arithmetic operations which they used when they went to the market. The procedures were written using Logo's graphics capabilities to draw letters and numbers. Using these procedures made them see the whole process of drawing letters and numbers by the turtle, step by step. When a letter or a number is typed on a computer keyboard, it can be seen written on the screen but, without the Logo procedures, the writing process is transparent to the user.

Decisions were made as a group process. This was not only a natural consequence of their usual behavior, it tended to create courage through mutual support.

The women preferred using the computer keyboard to type their names first with my help. They would repeat the process themselves until they felt confident about the right order of the letters. Then, spontaneously, they took a notebook and a pencil and started to write them down. They were deciding what to do next. Usually, for the married women, it was the husband's name which is written next, and then the children's names. For the single woman, Elisabeth, the next thing she wrote was a list of the French alphabet. She wanted to know them all at the same time. I was encouraging her to find a way of using these letters so that she would know how to pronounce them when they were combined together. This was how I introduced to them the notion of combining a consonant and a vowel to form a syllabic character and sound

like BA, BO, RI, etc. Each time I showed a new syllable, I asked them to find a word in which one could find the same sound. We then wrote the word. If I introduced a word in Wolof, I would give them the French translation. What was interesting for them was the ability of reading and writing with the French alphabet but the meaning of the French words were acquired at the same time. I let them practice with this syllable, building their own words in the same way they were creating their names.

The second week, they raised the question of learning numbers. Three of them (Aida, Anta and Ndiaya) knew how to count orally in French, Ndeye and Elisabeth did not. None of them had known the written forms of numbers. I started by showing them the 10 decimal numbers (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) on the keyboard and one by one one they typed them on the screen. They reacted in the same way as with the letters; they wrote them down. Aida asked why they did not go up to 10. Then, I showed her a CFAF100 coin and asked her to read the numbers on it, one by one (un, zero, zero). She did it and realized that this represented also CFAF100. Thus, I explained to them how numbers bigger than 10, were constructed. Aida, Anta and Ndiaya picked the idea up very fast and started to ask questions like: "Is 2 and 0 20? What do you call 1 and 1, 1 and 2, 1 and 3, etc?" Basically, as they knew the names and meanings of the numbers, they just had to learn the symbols representing them. Ndeye and Elisabeth were following very quietly; I asked them to play with the numbers and they began to make combinations; Aida, Anta and

Ndiaya sat back and were helping by saying the names of the numbers. Although I was listening, I tried to make them feel that I was not observing their work, until they asked me. In this way, they were committing themselves to this activity.

They would go home with their husband's name and some numbers in their notebooks, in order to impress their family. One could see how proud they were to show that they could do something on their own.

Second interview

The second and last interview was to evaluate their feelings about the machine they were discovering and themselves.

The questions were : What do you think about this machine? What would you like to do after these seminars, using what you have learned?

They said that they liked this teaching method with the machine because it was less frustrating for them to write a letter (with the computer). The machine would draw it correctly the first time and they could show with pride what came out of their typing.

The common answer about their future was to find a new job or to be more comfortable with the one they had (Anta, for instance). However, the older woman of the group who was 52 and had 10 children wanted to help other illiterate persons to learn how to read and write. She was ready to act, to

participate in improving her community.

3.2.3 Computers and the Hispanic Women

In order to test, evaluate and validate the above research, another study was carried out in Boston. The group studied in Boston was composed of Hispanic women who were non native speakers of English. I did this research to see how people from diverse cultures, eventhough they are from Third World countries, react to computers.

I worked in the context of a project using computers in the learning center Mujeres Unidas en Accion. located in Dorchester. I was in charge of the training of the teachers and the students. Six teachers and more than 30 women are being trained in Logo programming.

1. DEFINITION

Mujeres Unidas en Accion (United Women in Action), Inc. is an "English as a Second Language" program for low-income immigrant women from Spanish-speaking Latin American countries. They remain isolated by language and cultural barriers from the activities of the society at large. Mujeres Unidas en Accion breaks the women's isolation with an educational program geared toward the needs of Latina mothers with little previous education.

Mujeres Unidas en Accion's main objective is to teach English and Spanish to promote critical thinking, a positive self-image and self-reliance. The curriculum combines language instruction with raising people's consciousness about their ability to change their lives.

" The work with the computer was a probe to see if it could be used to enhance these goals. I think it did, though, once more it has to be noted that the experiments are at best suggestive. Other factors always come into play. In this case the fact that a woman from Africa was present as an instructor surely contributed as much as the computer to the learning experience."

2. ACTIONS

I worked directly with the (adult) students at the Mujeres center and also through their teachers who came to MIT for four Saturday morning training sessions.

The students at the center worked in groups of four to fourteen. Sessions of two hours each continued twice weekly from March through June. A total of 30 students participated.

The computer equipment consisted of four Atari 800 machines with color monitors and disk drives.

The computers were in the "recreation room" and all the students had access to them whenever they wanted. The students were free to choose their own projects of drawing using Logo turtle geometry. They could work together, on one computer or separately, depending on what they preferred. They could move from one machine to another, ask questions, sketch ideas on the blackboard, have a cup of coffee or tea, make a phone call, all in a relaxing

environment.

3. TEACHING METHODOLOGY

First, we will focus on the teacher and the student reactions. This will be followed by the psychological findings after an interview.

Reactions From the Teachers

When we introduced computers and Logo to Mujeres Unidas en Accion, we noticed that the teachers were anxious about mastering this new technology before they worked with their students. They were afraid of lacking a piece of knowledge while they were teaching their students; they did not want to feel frustrated, to lose control. This led some of them to try to learn faster, to know everything about programming in Logo in a short period of time, and that was not possible. Others almost dropped out. However, during this preliminary training at MIT, they got to understand that in Logo, it was fine to make mistakes or what Logo people call *bugs*. They began to realize that *bugs* are a vehicle to growth. As Seymour Papert said in <u>Mindstorms</u>, mistakes are part of the learning process. Students can learn from them. Teachers also understood that students are not required to wait for the teacher to tell them the correct answer to a problem, they can find it together.

Reactions From the Students

The students seemed very interested in and excited about the computers and

Logo, but they were timid or afraid. They would stare at it and admire the demonstrations we were making with colorful turtle drawings, but it was not easy to have one of them touch the keyboard. We realized that it was necessary to create links between computer use and their lives. Without a context, these graphics seemed beautiful but without meaning. We drew some colorful flowers and I told them that these designs could be used as ornamental models for dresses for their children or themselves. Rather than seeing the computer as an end, the students could see it as a means for thinking about issues which really mattered to them. This awakened their interest and provided reasons to become involved.

However, their involvement was still tentative. They lacked confidence in themselves and did not have a history of successful learning which would give them the strength to persevere. Initially, they were somewhat passive as if teaching was active and learning passive. This disarming notion of the role of the student was, perhaps, further aggrevated by their fear of using the computer. To counteract this behavior, I explained that we were all learning and teaching with this tool. We became students who they could teach, translating certain concepts into Spanish. The first step was to use Logo primitives and ask questions like: What is the Spanish translation of : forward, backward, right, left, clearscreen, showturtle, hideturtle, penup, pendown? We wrote these primitives and their equivalent in Spanish on the blackboard. Then, they started playing with the turtle and the Spanish primitives, drawing

squares (cuadrados), flowers (flores), cirles (circulos), step by step. When they discovered that they had something to teach they became more comfortable as students.

The second step was to program the computer by building procedures, i.e., teaching the turtle new things. Using procedures is a way of breaking a concept into its simplest components in order to understand it better. To explain the concept of procedures, we used cooking as a metaphor. If someone is given a foreign dish and does not know the basic ingredients the person needs the recipe. A recipe is like a procedure. Both are a collection of instructions which describe the process of doing some tasks. With this metaphor, we were able to use the experiences of these women as a bridge to the new ideas to which we were now exposing them. Cooking helped these women to understand programming and programming helped them to undertand cooking in a new way, as a procedure.

The third step came when they wanted to make a circle. At that time, they needed to know about degrees. We played turtle by trying to draw a circle by our feet, walking in a circle. We discovered that for each step forward, we made a small turn with our body. Having understood this, we tried to make the turtle do the same using the commands FORWARD 1 RIGHT 1 (walk 1 step and turn 1 degree). We had to repeat these instructions over and over until the circle started to appear. Then we used the command REPEAT to speed up the process counting how many times we had to walk and turn to draw the

circle. This turned out to be 360. Through this exercise, we covered the notions of degree, right angles and so forth. From this moment, they could build a procedure CIRCULO.

When they wanted to draw a flower using the square procedure with the instructions CUADRADO RIGHT 10, they raised the problem of how many times the turtle should repeat these commands to make the turtle come back to its initial position. Now that they knew the total number of degrees in a circle, it was possible to make them find how many times the turtle needed to turn RIGHT 10. We used the metaphor of dividing a pie into pieces of 10 degree angles. We drew this on the blackboard and they immediately found out that they would get 36 pieces of size 10 (degrees). The total size of the pie is then 36 times 10 which is 360. We then found the relation between 36 , 10 and 360.

A few sessions were devoted to Logo's list processing features. We began using the PRINT command to print names, sentences and numbers. The women were tempted to _say_ (instead of type) PRINT and then type what they wanted the computer to print. Of course, this didn't work and their reaction was : "the computer is deaf! _he_ can't hear!". By now, the women had become bold enough to criticize the computer. They continued exploring the PRINT command independently.

All the above steps were done with the active participation of the women,

using the blackboard whenever it was necessary, gaining more and more self-confidence.

As they became used to the basic turtle commands, they started debugging their procedures themselves. For example, one student was teaching another to draw a window juxtaposing 4 squares.

```
TO SQUARE
REPEAT 4 [FD 50 RT 90]
END
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The square has a side of 50 steps length. When the student typed SQUARE and pressed the return key, she got:

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Then she typed FD 40 and saw that 40 was not enough if she wanted the turtle to move on the top edge of the square. She typed FD 5 (still not enough), again FD 5, and the turtle stopped at the right position. She then realized that she needed 50 which was the size of the square side and she remarked: "if you have 40 and you want 50, you need 10 more". This was the way she understood her mistake and then she went on drawing the window but did not repeat the same bug.

Because, early in the process, we had taken turns teaching - the women

teaching Spanish, the teachers and myself Logo - it was natural for the women to teach the Logo programming they were learning to others. As in the above example, sharing knowledge is a natural consequence of Logo philosophy.

During the training period, more students became involved in playing with the computers. The youngest student, Ines, 18 years old, was the strongest foe of computers at the beginning. After the first demonstration, she said that she hated computers; and not only that, she was unwilling to communicate in English. However, after the teaching phases mentioned above, plus a special contract which arose between her and me (You teach me Spanish and I teach you English), she was the one who spent the most time working with the computer. (This contract was my strategy to break Ines's resistance to communicate in English with the teachers.) One day, Ines wrote down: "Now, I know that my life has a meaning, because I can teach, I can be helpful to people". In fact, she learned so rapidly that she was often teaching the older students.

During the second week in June, an interview revealed how the students' minds changed about computers and themselves. Most of them found it useful to know how to use computers for many reasons:

1) It could be easier for them to find a job.

2) Their children are learning to use computers at school, so they could more easily talk about their studies and discuss about other related things. For

example, they could talk about how a video game works. (One of the students has a computer at home which belongs to her son but she said that she never dared touch it until now.)

3) They understood now that computers are not responsible for the errors, but the people programming them. They also understood how computers work. One student said, "before learning Logo, I thought that computers knew everything and people just had to ask to get the right answer."

4) They knew new mathematical concepts (like the notion of geometric degrees) and new English words because of the Logo primitives, and new organizing principles (like proceduralization).

5) They became more self-confident. "I thought that I was not smart enough to deal with computers, but from now on, I change my mind", said a 52 year old woman.

3.2.4 Comparison study

1)Description of the cases

Criteria	Senegalese women	Hispanic women
Number of women	5	30
Number of hours of training	40 hours	40 hours
Number of computers	1	4
Computer language	French Logo	English Logo
Education	None	Little
Age range	from 20 to 52	from 18 to 52
Spoken language	Wolof	Spanish
Teaching language	French (foreign)	English (foreign)
Learning sites, Country of residence	House (informal), Senegal (Dakar)	School (center), USA, (foreign)
Country of origin	Senegal	Latin America

2) Analysis of the results

Criteria	Senegalese women	Hispanic women
Approaches to the computer	immediate, the computer was unknown	Fear, misconceptions
Social attitudes	worked separately, share the results, helped each other	worked together on one project per computer
Goals	social integration, economic benefits	social integration economic benefits
Self-assesment	active motivations	better self-image self-confidence
Literacy acquisition	Spelling, writing simple words (names) and numbers	Richer vocabulary Mathematical concepts (angles)

3) Interpretations of the Comparative Study

Unlike the Hispanic group who are already living in a computer culture, the Senegalese women had no idea of what a computer was. The Hispanic women have bank accounts in the Boston area, therefore, they are use to interacting with the computer when they go to a teller machine; they have heard that the operations are done by computers and not by human beings. They used to believe in the power of the computer because of its unchallengeable knowledge; "I thought the computer knew everything" said one of them. Another one, the 52-year old woman, said "I don't think I am clever enough to touch a computer". Thus, their fear of the computer came from their misconceptions of it. They were treating it with the respect of a human being and power of a machine. Maria said to me that she did not like computers because they caused a lot of trouble to her husband who had found his salary cut back by a large amount of money because of taxes he had already paid. When he inquired, he was told that it was the computer's mistake. All the advertisements about computers on the television fed these misconceptions. It took me two weeks to help them to overcome these fears.

The Senegalese women don't live in the same environment. There are no such advertisements on television, nor are there interactions with computers in their daily environment. Nevertheless, they had heard jokes about machines without understanding that it was about computers : "the machine skipped me this month", would say a husband to his wife to explain that he had not

been paid. They knew that a machine processed payrolls but how and what kind of machine remained a mystery. I assume that because they did not know about computers, they did not fear their first contact with it. Thus, the Senegalese women started manipulating the computer on the first day of training.

Sharing is one of the cultural bases of Senegal, each of the Senegalese women was working on her own project; she would eagerly show her projects to the others. This was inspiring for the others who would imitate or enhance projects they were shown. They were helping each other in solving a specific problem such as finding the name of a number.

However, the notion of enhancing a project was most significant. This relationship to knowledge as a changing or growing process is not customary in village life where traditional knowledge is passed from generation to generation unchanged.

The Hispanic women would work on the same project together. Each of them would add an idea in doing one or another part of the drawing.

In both cultures, sharing between women is dominant. Senegalese women go to the market together, organize celebrations together, exactly like Hispanic women. Thus, there is already a kind of commonality between each group, settled in the culture. Therefore, sharing ideas can be a natural extension of this established behavior.

The interviews revealed that the goals for both groups were the same; they all wanted to be literate for social integration and to be able to use the machine for economic benefits. The Hispanic group wants to be able to communicate in English with Americans in order to understand them more and to make themselves understandable. They would also like to know more about their children's studies including computer literacy, here in the USA. They know that computers represent the future in this society and knowing how to program them will give them opportunities.

The Senegalese women would like to be able to communicate with the educated people in French and to understand what their children are learning at school. For them, learning with computers allows them to know how to type with a keyboard, similar to a typewriter. This, they think, will facilitate having a job after their studies.

For the oldest Hispanic woman, (52 years), programming computers made her feel that she was still intelligent despite her age. Both she and Ines, the youngest hispanic woman, (18 years), acquired a better self-image after working with the computer. Ines gained confidence in herself when she realized that she can be "helpful" to others by teaching them how to program in Logo. The other women have a broader view of the society in which they live because they can understand it more. Now they know that "machine's mistakes" were making this society look awkward to them. Before this training, it seemed to them that there was nothing one could do against the

machine. One could not even express anger towards it! Now they realize that problems can be avoided or fixed by human beings.

Aida, the 52-year old Senegalese woman, after the training sessions said the same thing as Ines. She did not think about her age as a possible handicap to her activities. Her society never made her feel that she could be dumb. She knew she was just normal and her only handicap was her illiteracy. This age consideration seems negligible to the Senegalese who don't fear being old as do Westerners. She was motivated to act, to teach other illiterate people. For her own business, she would like to learn Logo programming to invent new designs for her pagnas. The other women were ready to go further in their studies for better economic benefits.

Because the Hispanic women were more or less literate (they knew how to spell) they were using Logo to draw pictures, geometrical figures. In contrast, the Senegalese group had never learned how to read and write, thus, they had to start by learning how to spell, how to read and write first. So, they were not programming their procedures. They were using ready-made Logo procedures allowing them to type letters and have them appear on the screen in the order they would enter them. Though they used the computer more like an intelligent and patient typewriter than a programmable machine, they glimpsed a process which will unfold for them in the future. I made them understand that the computer was taught to write these characters and that, in time, they could teach the computer others. They also appreciated the

precision and beauty that was possible through its use (the text they took home to their husbands and children) and the computers potential values in their lives (the acquisition of literacy and knowledge of arithmetic).

CHAPTER 4

POLICY FOR SENEGAL

In both the Senegalese and the Hispanic study, the introduction of computers to the women changed the way they think.

There were the Hispanic women who were intrigued with the computer. They knew it was a symbol of the future but were unprepared to use it critically. A learner's openness is a source of both vulnerability and growth. It is the teacher's responsibility to help develop critical thinking in the learner. It was necessary to show to the women the possibilities which computers could provide in their lives (e.g. literacy, ways of designing patterns, etc). In this situation, it is the teacher's role to quiet the fears and to develop bridges between personal experience, for example, programming as a cooking recipe.

I have mentioned the importance of the teacher in nurturing an environment which fosters an exchange of ideas and mutual support. Some aspects of this environment can be a natural extension of the family network, common in Senegal. Other aspects like the parents or teacher's authority figure are different. We have to remain sensitive to the social implications of changes. This includes ways of separating traditional practices which are healthy and those which may inhibit growth.

We know from Piaget that successful learning grows out of previous knowledge. This knowledge is not limited to what is taught in the classroom

but includes a learner's knowledge of the world, concept of self and relationship to culture. In good learning environments, the preservation of aspects of traditional knowledge is a necessary condition of learning anything else. An important part of our future research should be to develop new routes of entrance to computers through Logo from Senegalese culture. For example, I mentioned that with Sprite Logo, it is possible to animate shapes. Children could tell simple stories about their lives using these graphic capabilities. In the course of telling these stories and controlling the sprite objects, students learn important scientific concepts which prepare them for other topic areas. With this example, we can see an ideal merging of technology and culture.

Senegalese people need to be educated in a different way than the traditional one. Recent studies have shown that computers can bring a radical change in education. From Piaget's work, I distinguish four learning principles. First, cognition is action; second, learning depends on previous learning; third, knowledge must be applied; and fourth, growth happens in small steps. When a person is confronted with new learning, the Piagetian principle of assimilation-accomodation takes place. The person will use his former knowledge and the outside world, the environment, as means of accomodation to understand the new thing. Papert suggested that, with the turtle microworld, one can create an environment where abstract thinking can take place and powerful ideas can emerge and help to organize thinking

about specific matters. This microworld allows people (young and old) to build small blocks of knowledge to think with through the manipulation of small procedures. Computers can allow people to acquire combinatorial abilities. Computers can change the way people think about themselves. The way we think about ideas reflects the way we think about ourselves and about the world. They need to learn how to master the factors that can change their world and themselves. The computer is one of them.

One obvious example of creating the technology in the image of the culture in which it is being placed is by translating the computer language into the native language of the user. This is what we did.

The Computer "Speaks Wolof"

In the Senegalese research project, when we first raised the possibility that the computer could "speak Wolof", people were amazed. This was the first step toward demystifying technology, "the White's gift". At least this time, technology understands an African language; thus African people must be able to understand it. This is a big step in changing a piece of "Western magic" to a tool for expressing one's own thought. A new relationship with technology can be created.

We observed that children were programming in French and then discussing their procedures in Wolof, among themselves. Thus, it would be natural for them to program in Wolof. They would be able to see that technology can be

an extension of their own culture and expression. This determined our decision to translate Logo into our native languages immediately.

Therefore, we started working on the Logo translation into Wolof, assisted by the Third World project staff of the World Center for Computation and the Human Resource of Paris. Wolof Logo was completed in Dakar in December 1982. (Other studies are going on to translate Logo into the other native languages like Seereer, Pulaar, Manding, Diola, Soninke.)

Observations went on during the next school year from October 1982 to June 1983, with a larger number of computers, children and teachers. There were 10 computers, 40 children, and 12 Logo researchers.

Extension of the Project

One of the reasons why we extended our Logo activities to several schools was to observe its effect in many different educational settings. An important impact of this was to introduce the computer in the culture as an issue for discussion.

The characteristics of the 3 schools involved in the projects do not cover the different types of primary schools in a Senegalese city, in this case, Dakar. In other schools, classes are overcrowed. Others are located in the surburban areas. We decided to add two schools to widen our area of research by including other minority schools of different specifications, i.e. those with

overcrowded classes and/or located in the surburb. At present, five primary schools are involved in the project : The three ones mentioned earlier,

1) Franco-Senegalaise

2) Zone-B

3) Dieuppeul

and the two following ones :

4) Ouagou-Niayes is a popular school with overcrowded classes. In this school classes were filled with more or less than 100 children per teacher per room. It is in a poor neighbourhood and the children are from the same site.

5) Pikine is located in a near suburb of Dakar. It is frequented by middle-class and poor children.

In November 1982, one computer was installed in each of these five schools to enable teachers to be trained and to become familiar with the computers. Parents, teachers from other schools and students of different ages were allowed to come to the laboratory and use the machines.

At the beginning of the school year 1983-84, four computers were placed in each of the five schools to observe children using computers in their habitual school environment. Thus, for one month the Logo team supervised the training of the teachers. They went on observing the same groups of children

even though more children were using the computers.

In July 1983, we organized a seminar to inform people about the project. The children's parents, and staff from different Ministries (Education, Planning, Scientific and Technical Research) attended the seminar. The issues were about "computers and national languages", "computers and pedagogy" and "computer technology" in Senegal. This seminar led to creating three commissions which reflect the need of integrating technology in the Senegalese milieu.

Our continued observation of children in different environments will widen the research field and prepare the government for creating other learning centers throughout the country.

But how can we systematically address some of the complex issues addressed during the course of this thesis? By sub-dividing the problem into component tasks. There are several topic areas, and corresponding tasks, which have emerged. They fall into two classes. The first class of ideas are stimulated by the work with young children in the Senegalese research project currently supported by the government. This will be listed under the heading **The Future of the Project**. This is followed by an image of technology-based learning "Senegalese style" under the heading **A Possible Learning Environment in Senegal**. This second class of ideas under the heading **Suggestions for Future Research** are proposals for new research which

overlap with the aims of the current research. These suggestions pave the way towards implementing this image.

The Future of the Project

There are numerous issues that the Logo team should address in future phases of research. Some of these issues are listed below.

(1) Knowledge about dynamic processes are difficult to learn with paper and pencil yet natural in a computer setting using Sprite Logo which allows the control of several motion turtles at the same time (as many as 32 on some systems). Through an ability to set the color, shape, direction and speed of each turtle, children are able to do animation and learn about the motion of physical objects. These studies can help children to grasp scientific concepts important in physics, biology, in computer science and in other disciplines for which the Senegalese must become prepared.

(2) We must train other school teachers and develop teacher training materials. The teachers should be able to introduce new concepts to help the children progress in their learning. To make this happen, they should know more about the programming language and the technology being used. In Logo environments, children challenge teachers to learn as they teach. Teachers need to acquire a sensitivity to this working style which includes greater knowledge of the mental development of children.

(3) The cost of the use of computers in Senegal and the exploratory character of Logo require another strategy. Instead of installing computers in the classroom, I suggest that schools have a computer classroom. Thus students will use the computers by turn. We already installed 5 computers in each experimental school but the teachers need to schedule a time table to use the computer room. We need, then, to explore the relation between the activities in the computer room and the educational methods used elsewhere in the school.

(4) We know through Piaget and previous research of Papert that learning grows out of the learners' previous knowledge. By identifying links between Senegalese culture and Logo activities (For example, Senegalese folklore, music, language, etc.), we will be able to achieve broader success in our methods.

(5) Develop software projects in Logo curriculum and new software which enrich these links.

(6) Study the use of computers in new settings; for example, in kindergartens, centers for handicapped children, and in secondary schools.

The above research activities are currently in progress or planned for the near future. The following section provides one image of a Senegalese learning environment for the future.

4.1 A POSSIBLE LEARNING ENVIRONMENT IN SENEGAL

Imagine a large family house, the Senegalese village style, with a back yard. Many kinds of technological tools, from the simplest to the most sophisticated, are present in this back yard. Elderly people are trained to use them by specialists who may live in the same house or who are more or less related to the family. Children go back and forth to school, but they also have access to the tools at any time, whenever they feel like doing so. The other family members have other activities outside or inside the house. Operating manuals and books are available. In this environment, everyone will be teaching and learning. There could be an annual goal like the traditional "Fanal" (small festival) which was a organized at the end of each year. It could be an artistic exhibit with new clothing styles with computer drawn designs, with new dance steps, new songs, poems, etc. There could be a contest and prizes. The winner's work would be available to people so they could share their knowledge within different families.

Thus, not only would the learning environment be rich, but a healthy competition among different families and mutual support within one extended family would be preserved.

Computer networking will allow sharing ideas, storing them, developing them. The knowledge of elders can be investigated and developed. For example, traditional healing methods can be discussed and questions like these can be

asked : "Who knows how to cure such disease? Who knows someone who can deal with it? ..." This information can be stored in a data base that can be updated and used by younger people for further research. This is a way of both preserving and extending cultural values.

In addition, electronic networking will bring together the root family in the village and the relatives in the city because they could communicate more frequently. They could get moral support from each other. The children in the city would know more about those connections and the important role they play in their parents' life. They would not underestimate these values; even more, they would be in touch with their cousins, aunts and uncles. The notion of the extended family will be embodied in the use of technology in Senegal.

The elderly begin to feel as comfortable discussing the role of science and technology in the future of Senegal as they are discussing theology and the Koranic literature. Informal study groups grow out of school friendships or already existing social gatherings. Children dream of becoming scientists. Medical, agricultural and other research facilities blossom from a scientific culture which emerges from Senegalese social roots.

4.2 SUGGESTIONS FOR FURTHER RESEARCHES

(1) Researchers in the current project "Computers in Education" could use this thesis as a point of departure for more indepth research.

(2) To avoid the mistakes encountered in the use of other technology tools (radio and television) to improve education, researchers should study other testing methods to evaluate the use of computers and the Logo software. I believe that any hasty attempt to measure what is learned about a specific subject using Logo will result in a disappointment. Researchers must differentiate the use of Logo as an exploratory learning versus structured learning tool.

(3) The learning environment involving networking, presented earlier, can be realized in one of the neighbourhoods of Dakar or in the other cities of Senegal in the form of a case study of one extended family with members in both urban and rural areas.

(4) Collaborate with specialists to create Logo microworlds which will prepare children for the challenges that await them; for example, in biology, medicine, agriculture, etc.

(5) I would suggest that a poll on how computers are used in Senegal be done and related to other developing countries. This will allow people to see the various ways in which computers have been introduced for the purpose of learning.

(6) Concerning the use of native languages in the Senegalese literacy campaign, the study I did with the Senegalese illiterate women gave me a second thought about the validity of this campaign. The alphabet of Senegalese native languages is derived from the Latin alphabet. This makes it easy for the Senegalese, educated in French, to learn how to read and write in his or her mother tongue. This learning can be achieved in a matter of weeks! Plus, in Senegal, almost everything is in French which is the main reason why the illiterate women preferred to study in French. In addition, many other African countries use French as an official language; for example, Cameroun, Cote D'Ivoire, Guinee, Haute Volta, Mali, etc. Therefore, it will be easier to communicate with them in French. For these reasons, I would suggest a literacy campaign in French as a second language.

CHAPTER 5

POSTSCRIPT: MY OWN EXPERIENCE

In Senegal, social values such as the extended family can give underprivileged children the opportunity to succeed in learning. I was an underprivileged student in the French school system in which I was enrolled as a child.

My mother is illiterate and my father highly educated in Arabic. He has never understood how the French educational system works. I happened to go to school out of personal curiosity. I was seven and was going to a Koranic school in which I was doing very well. My step mother was going to register her son of my age to the French school. At that time, going to a French school implied wearing French style clothes and this was intriguing me. I wanted to be like the other girls of my age who were going to French schools, wearing short skirts and dresses, and also speaking French. I bothered my father night and day to have his permission to register. My step brother who was my age, was to be registered at this school. My father did not want me to go because for him, going to a French school meant not only leaving the Arabic school which was related to our family religion, but also going closer to another religion, Christianity. He said that the French were very demanding and that I would be always hurt by the teacher and he did not want this for me. For him, the result would be much pain and no promises at the end of the path.

Finally, as I was more stubborn than ever, he agreed to let me register. He said

Finally, as I was more stubborn than ever, he agreed to let me register. He said "you will find out yourself that it is not fun. I am sure you are not going to stay longer than one year". That was the challenge for me. I was determined to persuade him to my view. I wanted to learn and to succeed. While my father was skeptical, he remained supportive.

The home learning environment was terrible for me during the first four years. My mother would prefer that I learn to cook and to clean in preparation for domestic married life. She would become angry and impatient when I did my homework instead.

My father would never tell me to work on my school subjects. He did not understand what homework meant because this is not practiced in Koranic school. There, the student learns his lessons with the teacher and he does not have any homework. At least, this was his way of teaching it.

The outcome of this is that, actually, I am the only one out of ten children in my parents' house who went to school, to have attended college. I attribute this to a number of environmental factors.

At the age of twelve my parents were in an area of Dakar far from my school. They first moved during the school year and it was not convenient for me to change school before the end of the year. Thus, my father's brother, who was living near my school, offered to take care of me. He was a business man, as is my father, highly educated in Arabic but less involved in the Arabic literature.

it was necessary for every Senegalese to learn French in order to make a career. This was true for many inhabitants of Dakar.

I ended up spending six years in my uncle's house, in a very different environment than the one with my parents'. He really cared about his children's academic results, checking whether or not they had homework to do. We had a blackboard at home and would study over night. Everybody was studying very hard at home because not only were we under the pressure of my uncle, but also there was competition among children of different mothers. The one who would get the best grade would make his or her mother very happy and very proud.

This atmosphere stimulated my studies. This opportunity was possible because of the social resources which the extended family makes possible in Senegal. We can cite many other examples among the children from villages who come and stay in a family to achieve their studies in town.

Even though my father is not educated in French, he is a very flexible father. His children have the right to decide what they want to do. If he does not like the idea, he will just discuss it with you, very quietly, without anger and the final decision will be yours. He respects his children. His understanding makes it easier for him to teach us to preserve our cultural values. For example, I started French school with the childish idea of wearing western clothes like other girls of my age. He did not object to that. However, when I became

other girls of my age. He did not object to that. However, when I became adolescent, he started explaining to me how inconvenient these clothes could be for a girl and how striking and unrespectful they could be to older Senegalese people, mainly men. He was explaining that tight pants and short dresses attracted men's desire and women wearing them might be considered as a sexual object. I respected that explanation.

My mother's positive contribution was to explain how bad it was for a teenager girl, not married, to try to appeal to men. She did not find it subtle at all. She would say, "Where is the mystery? You should surprise your future husband. Who needs to marry a girl whose shape and legs every man has seen?" She would also praise the beauty and elegance of our traditional costumes, showing us old pictures and telling stories.

Another great role my mother had played in my life was to make me confident in myself as a girl. Until I was fourteen, my mother had only girls and her co-spouses (women sharing the same husband) had only boys. According to Senegalese culture, girls are supposed to leave the family house, to go and enrich another family which is her husbands'. Boys stayed and brought other women at home. Thus, boys are sources of wealth. But, this did not prevent my mother from teaching us that women too can bring something to their parents' home. Although she was eager to have boys, she never mentioned this to us; on the contrary, she used to say proudly to us that her girls would do better than any other boy. I think this gave me the idea of never thinking of

a man, even in other cultures, as superior to a woman. Maybe, unconsciously, I fought to prove my mother's hypothesis that I can bring something to the family.

My uncle was more radical than my father about Western clothes. Not only did he give us reasons similar to my father's, but he also prohibited the girls to wear them. But we found them pretty and fashionable. As we did respect him, we would put a "pagna" on top of the short dress or pants to hide them when we entered or left the house. Thus, we always had a "pagna" folded in our school bags. I kept this habit with my parents too.

Thus, I grew up in a family in which people respect each other's opinion and decision, yet firm in the values of the traditional culture. The extended family gave me the opportunity to be in an environment in which school was valued, competition and mutual support were present. Knowing about different cultures (here French and Senegalese) helped me to develop different points of views and nurture critical thinking.

I happened to change something I found very destructive in my family's customs which were the celebration expenses. Whenever there was a baby birth in the family, a big ceremony was organized on the 8th day and five hundred to one thousand people would attend it. Huge and expensive meals would be prepared to feed these people. Money would be distributed to some of them for one reason or another. The baby's parents would spend all the

money they had saved to welcome the baby. This would go so far that the following day, they would not have anything to eat. Every young person in my family knew the destructive side of this custom but did not dare stop it. Of course trying to stop it without a meaningful strategy could be controversial. For instance, the government itself, had tried to stop this in all Senegalese families by sending the police and asking for fines but this failed.

My first child was born in France. There was no such a ceremony. I received gifts from friends for the baby. The money my husband and I had collected was used for the baby, for his clothes, medical care, food, etc.

My second child was born in Senegal and my family organized the traditional celebration. The following morning, I felt so tired and dizzy that I even could not take care of my baby. My parents, my husband and I were all broke. I felt very depressed because I did not see a meaningful reason. It was just wasteful. Thus, I made my decision. I said this would not happen to me ever again. No one believed me.

With my third child, I said that I am not organizing anything. I knew that my mother could trap me by sending people to my house. Thus, I stayed at the clinic for ten days. Everybody was amazed. My brothers came to see me and said that they were glad that I had the courage to be the first one in the family to refuse birth celebration. Nobody said I did something wrong. Some people might think that but, because they respected my opinions and decisions, they

did not make any negative comments. This was a good start because one of my cousins was the next one to have a new baby and she did the same. My niece did the same. Now, it is considered to be something fashionable in my family and people recognize the value of this change.

I broke this cycle using my own strategy because by experience I had the opportunity to filter what was destructive in my culture and what was worth preserving. Paradoxically, the traditions which made me thrive in the course of my exposure to new ideas and western culture became the target of my criticisms. However, the extended family, with its supportive environment and constructive competitive spirit, gave me the opportunity to succeed in my studies and still reminds me that the inevitable cultural changes should embody these traditions.

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APPENDICES

A- ALPHABET PROCEDURES

```
POUR ZERO
FIG [1 2 3 4 5 6]
FIN

POUR FIG :L
VECT 6 DR 90
VECT 1 DR 90
VECT 2
VECT 3 DR 90
VECT 4 DR 90
VECT 5 DR 90
VECT 7
RE 20 GA 90
CT
FIN

POUR M
FIG [2 3 5 6]
BC AV 20 DR 135 AV 15
GA 90 AV 15
FIN

POUR E
FIG [1 4 5 6 7]
FIN

POUR D
ZERO
FIN

POUR R
P
DR 90 AV 5 DR 45 AV 25
FIN

POUR I
UN
FIN

POUR F
FIG [1 5 6 7]
FIN

POUR S
CINQ
FIN
```

```
POUR NEUF
FIG [6 1 2 3 4 7]
FIN

POUR SEPT
FIG [1 2 3]
FIN

POUR SIX
FIG [1 6 5 4 3 7]
FIN

POUR QUATRE
FIG [6 7 3]
FIN

POUR TROIS
FIG [1 2 7 3 4]
FIN

POUR DEUX
FIG [1 2 7 5 4]
FIN

POUR VECT :N
SI MEMBREP :N :L [BC] [LC]
AV 20
FIN

POUR CONSTRUCTION :S :V :C
SI (OU :S = [] :V = [] :C = []) [STOP]
EC (PHRASE PREMIER :S PREMIER :V PREMIER :C)
CONSTRUCTION SP :S SP :V SP :C
FIN

POUR CINQ
FIG [1 6 7 3 4]
FIN

POUR HUIT
FIG [1 2 3 4 5 6 7]
FIN

POUR UN
FIG [2 3]
FIN

POUR ,
LC DR 90 AV 15 GA 90 BC
FIN
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```
POUR O
ZERO
FIN

POUR G
FIG [1 3 4 5 6]
FIN

POUR L
FIG [4 5 6]
FIN

POUR P
FIG [1 2 5 6 7]
FIN

POUR B
HUIT
FIN

POUR A
FIG [1 2 3 5 6 7]
FIN

POUR T
FIG [5 6]
AV 20 DR 90
BC AV 10 RE 20
FIN

POUR V
BC DR 30 AV 40
RE 40 GA 60 AV 40
CT
FIN

POUR Q
FIG [1 2 3 6 7]
FIN

POUR C
FIG [1 4 5 6]
FIN

POUR N
FIG [2 3 5 6]
BC AV 20 DR 135 AV 25
FIN

POUR Z
FIG [1 4]
AV 20 DR 90 AV 20
BC DR 115 AV 45
FIN
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```
POUR S1
AV 3 GA 45 RE 4 GA 45 RE 4 GA 45 RE 3 GA 45 RE 6 GA 45
RE 3 GA 45 RE 4 DR 45 RE 3 DR 45 RE 4 DR 45
RE 3 DR 45 RE 4 DR 45 RE 3 DR 45
FIN

POUR H
FIG [2 3 5 6 7]
FIN

POUR J
FIG [2 3 4]
FIN

POUR K
FIG [5 6]
FIN

POUR Y
BC DR 30 AV 20 RE 20 GA 60 AV 20
LC CENTRE BC DR 30 RE 20
CT
FIN

POUR U
FIG [2 3 4 5 6]
FIN

POUR W
V LC CENTRE DR 90
AV 20 GA 90 V
FIN


POUR X
BC DR 30 AV 20 RE 20 GA 60 AV 20
LC CENTRE BC DR 180 DR 30 AV 20 RE 20 GA 60 AV 20
CT
FIN

?
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B- MAPS OF SENEGAL

OCÉAN GLACIAL ARCTIQUE

GROENLAND

CANADA

AMÉRIQUE

ISLANDE

NORVÈGE
SUÈDE
FINLANDE

U. R. S. S.

ANGLETERRE DANEMARK
IRLANDE PAYS-BAS
BELGIQUE R.D.A. POLOGNE
TCHÉCOSLOVAQUIE
Paris AUTRICHE HONGRIE
FRANCE SUISSE ROUMANIE
YOUGOSLAVIE BULGARIE
ITALIE GRÈCE TURQUIE

MONGOLIE

JAPON

CHINE

ÉTATS-UNIS
DU
New York
NORD

PORTUGAL ESPAGNE
Gibraltar
MÉDITERRANÉE
LIBAN SYRIE
ISRAEL IRAK IRAN
AFGHANISTAN
PAKISTAN
NÉPAL

OCÉAN

MAROC
TUNISIE
ALGÉRIE LIBYE
Le Caire JORDANIE
ARABIE
SÉOUDITE
ÉGYPTE
Djeddah

INDE

SUD-EST
ASIATIQUE

MEXIQUE

AMÉRIQUE
CENTRALE

SAHARA
OCC.
MAURITANIE
MALI
NIGER
TCHAD
SOUDAN
T.DJIBOUTI
ÉTHIOPIE

DAKAR
NTÉ
VOLTA
NIGÉRIA
RÉP. CENTRAF.
SOMALIE

MALAISIE

OCÉAN

VENEZUELA
COLOMBIE
GUINÉE-BISSAU GUINÉE
SIERRA LEONE
LIBÉRIA
GHANA BÉNIN
CÔTE
D'IVOIRE TOGO
CAMEROUN
CONGO
UGANDA
KENYA

Équateur

INDONÉSIE

OCÉAN

AMÉRIQUE
Natal
BRÉSIL
GABON
CABINDA
ZAÏRE
RWANDA
BURUNDI
TANZANIE

PACIFIQUE

DU
Rio de
Janeiro
SUD

ATLANTIQUE

ANGOLA
ZAMBIE
ZIMBABWE
NAMIBIE
BOTSWANA
MALAWI
MOZAMBIQUE
MADAGASCAR

AUSTRALIE

INDIEN

ARGENTINE
RÉPUBLIQUE
SUD-
AFRICAINE
Le Cap
SWAZILAND
LESOTHO

SÉNÉGAL

——— Routes maritimes
——— Lignes aériennes

✸ Principaux fournisseurs
✿ Principaux clients

0   2 000 km

Richard-Toll — Vallée du fleuve — St. Louis — Canne à sucre — Niayes — Cayor — Diourbel — DAKAR — Thiès — Diourbel — Tabac — Kaolack — Siné Saloum — Coton — Tambacounda — Sénégal oriental — Gambie — Casamance — Ziguinchor — Kédougou — 100 Km

Podor — Dagana — St. Louis — Louga — Kébémer — Linguère — Mekhé — Thiès — Tivaouane — Mbacké — Bambey — Rufisque — Diourbel — DAKAR — Mbour — Kaolack — Kaffrine — Tambacounda — WOLOFS — SÉRÈRES — PEULS — TOUCOULEURS — PEULS — SARAKOLLÉS — Matam — Bakel — Bignona — Kolda — MANDINGUES — PEULS — DIOLAS — Kédougou — Oussouye — Ziguinchor — 100 Km

700 000 à 800 000 hab. — 10 000 à 50 000 hab.
500 000 à 100 000 hab. — moins de 10 000 hab.