

**Logo
Philosophy
and
Implementation**

TABLE OF CONTENTS

INTRODUCTION

| | |
|---|----|
| What is Logo? Who Needs It? <i>by Seymour Papert</i> | IV |
|---|----|

THE COMPUTER IN COSTA RICA:

| | |
|---|---|
| A New Door to Educational and Social Opportunities <i>by Clotilde Fonseca</i> | 2 |
|---|---|

THE SAINT PAUL LOGO PROJECT:

| | |
|--|----|
| An American Experience <i>by Geraldine Kozberg and Michael Tempel</i> | 22 |
|--|----|

THE RUSSIAN SCHOOL SYSTEM AND THE LOGO APPROACH:

| | |
|---|----|
| Two Methods Worlds Apart <i>by Sergei Soprunov and Elena Yakovleva</i> | 48 |
|---|----|

A LOGO POSTCARD FROM ARGENTINA

| | |
|-----------------------------------|----|
| <i>by Horacio C. Regini</i> | 78 |
|-----------------------------------|----|

LOGO IN AUSTRALIA:

| | |
|--|----|
| A Vision of Their Own <i>by Jeff Richardson</i> | 96 |
|--|----|

THE CONSTRUCTIONIST APPROACH:

| | |
|---|-----|
| The Integration of Computers in Brazilian Public Schools <i>by Maria Elizabeth B. Almeida</i> | 106 |
|---|-----|

PROJECT LIGHTHOUSE IN THAILAND:

| | |
|--|-----|
| Guiding Pathways to Powerful Learning <i>by David Cavallo</i> | 128 |
|--|-----|

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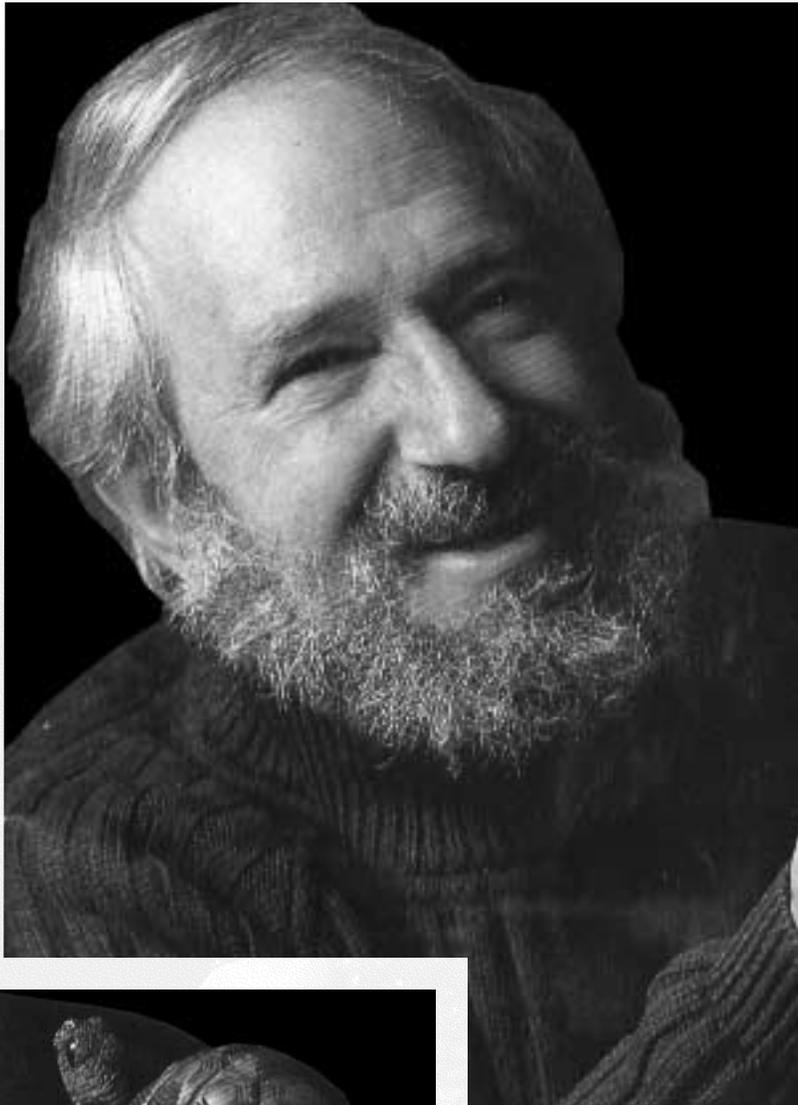
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Introduction: What is Logo? And Who Needs It?

By Seymour Papert

Seymour Papert is currently LEGO Professor of Learning Research and Director of the Epistemology and Learning Group at M.I.T. He contributes actively to LCSI research and development keeping LCSI abreast of innovations in the fields of education and technology.

In 1993, Dr. Papert was given the Lifetime Achievement Award by the Software Publishers Association. He was the sixth individual to be so honored. He has published several books, including *Mindstorms*, *The Children's Machine*, and *The Connected Family*, all acclaimed discussion of computers, children and learning. Dr. Papert's interest with children grew as a result of his work with Jean Piaget in the late 1950's and early 1960's in Switzerland.

The great religious teachers of the world have understood that if you want to communicate a powerful idea you may do better by telling stories than by spinning abstract definitions. In the spirit of their ways I am sure that this book of stories, each of which describes a large scale Logo implementation in a different country, will make a significant contribution towards communicating the powerful idea that is captured for me, as for the authors of its chapters, by the word “Logo.”

Why then does it need an introduction? Don’t the stories suffice in themselves? Sure: the stories would suffice. But the idea that the stories will be enhanced by commentaries is in line with the practices of the religious teachers I take as my model and does not at all contradict the principle that concrete stories are better vehicles for communicating ideas than abstract theorizing. The point is the same as the first of two extensions to the principle of learning by doing: *we learn better by doing ... but we learn better still if we combine our doing with talking and thinking about what we have done.* The chapters of this book are written by people who not only have done something important but who have thought and talked a lot about their actions. What I plan to do in this introduction is just a little more of the talking part.

A good starting point is to ponder what the several projects described in the chapters have in common. What makes them all *Logo projects*?

An easy answer might seem to be that they all use a programming language called “Logo.” They do, but this is not enough to qualify, for when you read the chapters you will see that what is important to the writers is not the programming language as such but a certain spirit of doing things: I (and again I guess all the authors) would see many projects that use Logo as thoroughly counter to the “Logo spirit.” And, in the other direction, I can imagine, though I have seldom seen, computer-based projects comparable in spirit and scope to those described in this

book which use a different programming language. So the question posed becomes, “what is this Logo spirit?” And “why is this spirit so rarely found in computer work without Logo?”

I have myself sometimes slipped into using an answer given by many Logoists in the form of a definition: “Logo is a programming language plus a philosophy of education” and this latter is most often categorized as “constructivism” or “discovery learning.” But while the Logo spirit is certainly consistent with constructivism as understood, for example, by the author of the Brazilian chapter, there is more to it than any traditional meaning of constructivism and indeed more to it than “education.” In fact a feature of this book itself exemplifies an aspect of the something more. As you read it I want you to consider the idea that the right answer to “what is Logo” cannot be “An X plus a Y.” It is something more holistic and the only kind of entity that has the right kind of integrity is a culture and the only way to get to know a culture is by delving into its multiple corners.

The feature of this book that begins to make my point appears in the fact that although the book is published by a company that has a commercial interest in Logo, it nevertheless reports as many examples of difficulties in the implementation of Logo as examples of uncomplicated successes. This acceptance of “negatives” is very characteristic of the Logo spirit: what others might describe as “going wrong” Logoists treat as an opportunity to gain better understanding of what one is trying to do. Logoists reject School’s preoccupation with getting right or wrong answers as nothing short of educational malpractice. Of course rejecting “right” vs. “wrong” does not mean that “anything goes.” Discipline means commitment to the principle that once you start a project you sweat and slave to get it to work and only give up as a very last resort. Life is not about “knowing the right answer” – or at least it should not be – it is about getting things to work! In this sense you will see on reading the chapters that the writers

“practice what they preach” or rather “use practice in place of preaching” and in so doing make the moral of the story stand out more strikingly than any abstract words could possibly do.

The frame of mind behind the Logo culture’s attitude to “getting it to happen” is much more than an “educational” or “pedagogic” principle. It is better described as reflecting a “philosophy of life” than a “philosophy of education.” But insofar as it can be seen as an aspect of education, it is about something far more specific than constructivism in the usual sense of the word. The principle of getting things done, of making things — and of making them work — is important enough, and different enough from any prevalent ideas about education, that it really needs another name. To cover it and a number of related principles (some of which will be mentioned below) I have adapted the word constructionism to refer to everything that has to do with making things and especially to do with learning by *making*, an idea that includes but goes far beyond the idea of learning by *doing*.

I shall return to the idea of constructionism but want to emphasize here what might for educational decision-makers be the most important difference between the “n word” constructionism and the “v word” constructivism. The v-word refers to a theory about how math and science and everything else is learned and a proposal about how they should be taught. The n-word also refers to a general principle of learning and teaching, but it also includes a specific content area that was neglected in traditional schools but which is becoming a crucial knowledge area in the modern world. Choosing constructivism as a basis for teaching traditional subjects is a matter for professional educators to decide. I personally think that the evidence is very strongly in favor of it, but many teachers think otherwise and I respect their views. But the constructionist content area is a different matter. *This is not a decision about pedagogic theory but a decision about what citizens of the future need to know.* In the past most

people left the world only slightly different from how it was when they found it. The rapid and accelerating change that marks our times means that every individual will see bigger changes every few years than previous generations saw in a lifetime. So this is the choice we must make for ourselves, for our children, for our countries and for our planet: acquire the skills needed to participate with understanding in the *construction* of what is new OR be resigned to a life of dependency.

Another way in which the stories in this book go beyond the description “programming language plus constructivism” is captured in the Costa Rican story by a student whose surprise at seeing a teacher learn evokes the exclamation: “Wow, I never knew that teachers have to study.” A crucial aspect of the Logo spirit is fostering situations which the teacher has never seen before and so has to join the students as an authentic co-learner. This is the common constructivist practice of setting up situations in which students are expected to make their own discoveries, but where what they “discover” is something that the teacher already knows and either pretends not to know or exercises self-restraint in not sharing with the students. Neither deception nor restraint is necessary when teacher and student are faced with a real problem that arises naturally in the course of a project. The problem challenges both. Both can give their all.

I like to emphasize this last point by the following analogy. The best way to become a good carpenter is by participating with a good carpenter in the act of carpentering. By analogy the way to become a good learner is by participating with a good learner in an act of learning. In other words, the student should encounter the teacher-as-learner and share the act of learning. But in school this seldom happens since the teacher already knows what is being taught and so cannot authentically be learning. What I see as an essential part of the Logo experience is this relationship of apprenticeship in learning. Logo, both in the sense of its computer system and of its culture of

activities, has been shaped by striving for richness in giving rise to new and unexpected situations that will challenge teachers as much as students.

Doubts about the feasibility of Logo are often expressed by policy-makers who say “but *our* teachers can’t do that.” I always ask: “Why not?” And policy-makers in several dozen countries have told me that it is because their teachers have limited education, are not used to such ideas, are conservative, lazy, dominated by unions... you name it. Several of the stories in this book, notably the St. Paul story, the Thai story, and again the Costa Rican story bear on these beliefs, exposing them to be somewhere between superstitions and cover stories for reluctance to change. The experiences reported in the stories confirm that the skeptical policy-maker is absolutely right but only if “can’t do it” means “can’t do it without getting a chance to learn how.” And they suggest that “getting a chance to learn how” might require far more than is usually offered – a few hours of staff development time under the guidance of a “trainer” from some computer company. But it can be done. In fact one of the more impressive features of this collection is providing insight into how seriously the Logo culture approaches teachers as intellectual agents. The teacher development components of the projects not only give an exceptional level of time and support but also are outstanding in conception and organization. This costs, *but Clotilde Fonseca gives compelling reason to believe that there are very few countries in the world which could not do as well if they had the political will that Costa Rican leaders have brought to bear on education.*

I turn next to something that many readers might perceive as inadequately represented in the stories: the role of the Internet and the World Wide Web. Indeed for many the low-key presence of the “information highway” could give the stories a slight feel of coming from another

epoch. (How quickly we are overtaken by the latest fashions!) In part the perception is correct: because the prominence of the Web is only a few years old and because these stories are selected to show what can be done in more than just a few years, it is inevitable that this component is less present than it would be in a successor volume to this written in five years time. But in part the sense of being old-fashioned offers a salutary correction to an unbalanced focus on connectivity in contemporary thinking about computers and learning. To explain what I mean I draw on some ideas that I developed in the 1998 Colin Cherry Memorial Lecture which you can find in the ConnectedFamily.com web site. (As you see, I might want to redress the balance of attention given to the Web, but I certainly do not neglect its value.)

In that lecture I complained about the harmful effect on popular culture of using the name “information technology” to refer to what would more properly be called “digital technology.” In a very technical sense of “information” everything digital belongs to information theory. But for most people the word “information” has a popular sense of getting something that informs. But most of what computers are used for has nothing to do with information in this ordinary sense. Think of making a spaceship. The task of designing the space shuttle would be too complex for any human mind to manage without computers and, even further from the informational aspect of computing, the control mechanisms to guide it make extensive use of digital chips.

In short I like to recognize – only slightly simplifying a complex issue—two wings of digital technology: the technology as an informational medium and the technology as a constructional medium in which garb it is more like wood and bricks and steel than like printing or television. Of course the two wings are equally important; but popular perception is dominated by the informational wing because that is what people see and ceaselessly hear about

and that is what reflects the predominant role of informational media in their lives.

Now let me turn to education to recognize that this one-sidedness in perception of the technology has produced a deep distortion of how people think about its contribution to education. This has happened because education itself has two wings which also could be called “informational” and “constructional.” Part of learning is getting information which might come from reading a book or listening to a teacher or by visiting sites on the Web. But that is only one part of education. The other part is about doing things, making things, constructing things. However here too there is an imbalance: in large part because of the absence of suitable technologies, the constructional side of learning has lagged in schools, taking a poor second place to the dominant informational side.

In my view, a key to the current trends of discussion about technology and education is an ironic fact about the imbalance between informational and constructional. Whereas the most qualitatively original contribution digital technology could make to education lies in redressing the imbalance, in fact the imbalance is increased by popular perception that so strongly favors the informational sides both of schools and of computers. Educational reform is being seriously held back by this match between an unrecognized dichotomy in digital technology and a generally unrecognized dichotomy in the education system. As a result, although there is a great deal of talk about putting more control in the hands of the students and replacing teaching by facilitating, in fact the image of computers in school becomes one of supporting the traditional role of teaching.

To bring this discussion back to the Logo culture’s view of the teacher, I want to register my horror when I hear talk about how the Web will allow every student to be taught by the “best teacher” in the world. Nothing could be further from our view in which the best teacher in the world

is one who has a close and empathic relationship with students. The primary way that digital technology will help is to provide more opportunity for wonderful teachers to work with wonderful students on projects where they will jointly exercise wonderfully powerful ideas. This view does not in any way put down the value of the Internet. Quite the contrary, it leads to a greater recognition of its power. The true power of both sides – the constructional and the informational sides — of the digital technology comes out when the two are put together. The Web has been criticized – in my view quite rightly – for encouraging the superficial “grasshopper mentality” seen in a lot of surfing. The right response to the criticism is neither to justify nor to ban surfing, but to make it more purposeful by integrating the use of the Internet into constructionist project work. For students engaged in projects, the Web is a highly focused tool for finding relevant material, relevant ideas and even collaborators.

Reference to the very powerful idea of powerful idea brings me back to my promise to add a second extension to the principle of learning by doing. Yes doing is a good way to learn. And it is made better by talking and thinking. But we learn best of all by the special kind of doing that consists of constructing something outside of ourselves: a child building a tower, writing a story, constructing a working robotic device or making a video game are all examples of constructing and the list goes on indefinitely. All these activities have several features in common. They are subject to the test of reality; if they don’t work they are a challenge to understand why and to overcome the obstacles. They can be shown, shared and discussed with other people. But what causes some of them to be specially valued in the Logo culture is their contact with powerful ideas that enables them to serve as transitional objects for the personal appropriation of the ideas.

In this respect, it is Horacio Reggini’s contribution to this book that stands out although others are not far behind. Let me tell an oversimplified historical story to make a

point and introduce two epistemological words. The story is about geometry which began, as the name implies, as the art of measuring the earth. But at the beginning, it was a flat two-dimensional earth, no doubt part of the commerce and management of fields. Geometry became immensely more powerful when it took off into three dimension space. Pyramids could be built and the movements of the stars used for navigating the seas. The effort and interest of such feats of the mind deepened thinking so much that Euclid could bring geometry back to the plane in the spectacular construction of his system of axioms and proofs. But here is a paradox of our educational system: we want children to learn at least some of Euclid but deny them the opportunity to develop the wings of the mind that led geometry to its power. Why would anyone do such a foolish thing?

I think that the answer is really quite obvious: *The culprit is the influence of technology.*

To people who think that “technology” means stuff like computers and airplanes, this will appear absurd. The relevant aspects of the school geometry curriculum were established long before any of those existed. But pencil and paper, and chalk and slate and even sticks to draw in the sand are also technology. As Alan Kay is fond of remarking, most people just don’t call it technology if it existed before they were born. But its harmful results can be just as real. It was that old technology that pulled geometry down to earth, for it is essentially a technology for drawing static figures on flat surfaces. Thereby it contributed to disempowering geometry by taking away its most powerful uses and its most powerful intellectual connections not only with the stars but with the way machines work and flowers and earthquakes and with other powerful ideas. I see Reggini’s wonderful uses of 3D Logo turtles as a valiant attempt to re-empower the disempowered ideas of geometry. Not the only one: another way in which the technology of the pencil disempowers geometry is by confining it to static drawings. Much of

my own current work consists of extending earlier ideas about using turtles to re-empower geometric ideas by breaking the static barrier.

Before making my final point let me review some of the features of the Logo culture that I have mentioned in relation to the chapters of this book.

- The Logo programming language is far from all there is to it and in principle we could imagine using a different language, but programming itself is a key element of this culture.
- So is the assumption that children can program at very young ages.
- And the assumption that children can program implies something much larger: in this culture we believe (correction: *we know*) that children of all ages and from all social backgrounds can do much more than they are believed capable of doing. Just give them the tools and the opportunity.
- Opportunity means more than just “access” to computers. It means an intellectual culture in which individual projects are encouraged and contact with powerful ideas is facilitated.
- Doing that means teachers have a harder job. But we believe that it is a far more interesting and creative job and we have confidence that most teachers will prefer “creative” to “easy.”
- But for teachers to do this job they need the opportunity to learn. This requires time and intellectual support.
- Just as we have confidence that children can do more than people expect from them we have equal confidence in teachers.
- We believe in a constructivist approach to learning.
- But more than that, we have an elaborated constructionist approach not only to learning but to life.
- We believe that there is such a thing as becoming a good learner and therefore that teachers should do a lot of

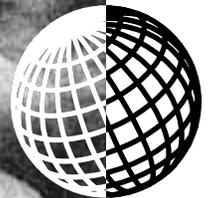
learning in the presence of the children and in collaboration with them.

- We believe in making learning worth while for use now and not only for banking to use later.
- This requires a lot of hard work (we've been at it for thirty years) to develop a rich collection of projects in which the interests of the individual child can meet the powerful ideas needed to prepare for a life in the twenty-first century.

And even that is not all.

The “we” behind the thirty years of hard works contains the essence of an answer to the question: why are there so few educational projects like the ones represented in this book but based on a different programming tool? The Logo “we” represents a large number of people: well over a hundred books have been devoted to Logo, many more discuss it seriously as part of more general topics, several thousands of teachers have published short papers reporting something they have done with Logo. The real asset of Logo consists of the two necessary conditions for the growth of a culture: community and time.

Looking into the future, I certainly see the likelihood of new and more powerful programming systems. Many have been suggested. But one can be sure that an alternative culture of educational programming will not emerge soon, or ever. Such a process needs time, and all indications are that likely contenders for leadership in any such movement have espoused the central principles of the Logo culture. This claim is not based on an arrogant belief that we the inventors of the Logo philosophy are smarter than everyone else. It is based on the belief that the Logo philosophy was not invented at all, but is the expression of the liberation of learning from the artificial constraints of pre-digital knowledge technologies.





The Computer in Costa Rica: A New Door to Educational and Social Opportunities

by Clotilde Fonseca

Ms. Fonseca was Founding Director of the Costa Rican Computers in Education Program and of the Omar Dengo Foundation from 1988 to 1994. She has also been Executive President of the Costa Rican Social Assistance Institute, the national institution in charge of anti poverty programs (1994-1995). At present Ms. Fonseca is a professor at the University of Costa Rica and Executive Director of the Omar Dengo Foundation.

She is particularly interested in the democratic uses of new technologies, especially in the use of computer technology for the development of talent, creativity and cognitive skills. Ms. Fonseca is the author of the book *Computers in Costa Rican Public Schools*, and of many articles in the areas of education, technology and socio-economic development. She has also published on aesthetic and literary topics.

George Bernard Shaw, the great English dramatist and social critic, is credited with having said that at the age of five he was forced to abandon his education in order to attend school. Shaw's insightful statement throws light on the difference between learning and schooling — a distinction that has received significant attention in recent years. To most children in the developing world, school offers little beyond basic instruction. In the anxious race to instill basic literacy and job-related skills, teachers and institutions have frequently failed to both adequately teach those skills and to respond to children's interests and cognitive development. Like Bernard Shaw, many children would no doubt rather learn from more direct and vital sources.

Furthermore, in a world progressively subject to technological change, these children have had little, if any, contact with technology. To children in the developing world and in deprived areas of more developed societies, technology is a distant symbol of a future that they can only observe slipping through a paradoxically technological window — that of the television screen.

FROM HOPES TO OPPORTUNITIES

Computers, on the other hand, open up a new dimension; they offer the means to turn elusive hopes into concrete opportunities. In the words of a Costa Rican teacher: "Television is a window that lets you look into the future. Through it, we can get glimpses of what a future world for us might be like. But the computer opens a door through which we can enter that future."

Like this teacher, many of us are convinced of the computer's potential as a door to development, especially for young people in deprived sectors of society. This is particularly the case when the computer is seen not only as a technological object, a symbol of progress, but as part of an emerging culture of human transformation. The cost effectiveness of computers in schools must be seen not

only in terms of their use as effective teaching tools but also within the context of the more complex and far-reaching issues of human and national development. According to Seymour Papert, the real task of the educational community is to reformulate education itself while exploiting the computer's potential in the learning process (1987).

COMPUTERS AND EDUCATIONAL CHANGE: THE CASE OF COSTA RICA

Although the computer is still generally perceived as a mathematical and word processing machine, it has increasingly been used to transform the traditional school environment and to accomplish the higher goal of more humanized forms of development. One such instance has been an initiative of Costa Rica¹, which was launched as an act of national assertion, as an investment in the talent of its teachers and young people. The way in which computer technology was introduced to Costa Rican schools exemplifies what a developing nation can accomplish given a sustained commitment to its vision of the future.

Established in 1988, the Costa Rican Computers in Elementary Education Program was established to prepare a new generation of children and teachers for the challenges of the future. From the beginning, its main emphasis has been on the development of creativity, thinking skills and problem-solving abilities — long-term benefits that are expected to impact upon the country's socio-economic and technological development.

Equity in access to technology and more qualitative forms of education have been central considerations in the program design. Most projects that invest in educational technology in the developing world provide computers to high-school students to develop job-related skills. The

¹ Costa Rica is a small Central American nation with a population of 3.5 million inhabitants and a per capita income of US \$2,721 (1997) .

Costa Rican program broke away from the international standard model by focusing on very young children first, and for cognitive rather than computer literacy or computer-assisted instruction purposes. The program also broke new ground by giving priority to underprivileged rural and urban school populations.

Organized as a joint effort of the Ministry of Public Education and the Omar Dengo Foundation (ODF), the program has relied on countless individual, community, institutional and government resources and efforts. Initially, it reached over 140,000 pre-school and elementary school children a year — i.e., 30 percent of the country's total elementary school population. Computer labs were originally installed in 158 rural and urban schools throughout Costa Rica. In its first decade, the program provided services to over a million children, teachers and adults in all regions of the country — a significant accomplishment for a developing nation with a population of 3.5 million.

In 1998 the program went into its second phase, enabling it to reach approximately 225,000 children annually — i.e., one out of every two school children in the country. Participating schools are granted a laboratory with 20 multimedia computers organized in a local network, as well as a scanner, a printer, and access to the Internet. Computer labs are equipped with MicroWorlds, the basic educational software used in the program. Schools also have access to Microsoft Windows and Office, as well as the Encarta Encyclopedia and Atlas. These programs are used within the educational setting as well as for community-related activities. The number of computers assigned to each school is based on the number of students per class, not the size of the school. Students work at each computer in pairs, thus stimulating team work and collaborative learning.

The ODF also provides students and teachers with a telecommunications infrastructure and related support

services, which promote learning and exchange activities. For over five years many students have been able to use e-mail and to create and publish an electronic magazine, which has a virtual editorial committee organized by children in different regions of the country. The international telecommunications activities have also been very enriching. They have provided new cultural experiences and generated bonds of friendship and solidarity.

As of 1998, with the introduction of the new computers and telecommunications platform, students and teachers can develop and publish their own web materials. Initially, students will use the computer lab's Intranet to share their projects. They also have access to e-mail and web services through both the Internet and the program's Extranet. On-line and virtual learning experiences for both students and teachers are being developed. Networking has always been seen as an exploration and problem-solving tool to enable students and teachers to transcend geographical and cultural limitations, which include the lack of libraries and other educational resources.

Since the program has a strong educational focus, the foundation also organizes intensive training and follow-up on how to use the computers and networking capabilities within a personally and educationally meaningful environment. At present, the ODF annually trains 7,500 lab tutors, program advisors, teachers, principals and educational authorities. During weekends, after-school hours, and vacation periods, the foundation also organizes courses directed to different members of the community. These courses help train individuals, workers and community groups to use productivity tools, as well as computer and Internet applications.

As of 1998, multimedia computers are also being installed in 70 small multigrade schools located in rural areas. This new dimension of the program involves research development in the context of educational uses of computers in

the classroom. The Ministry of Public Education has also created a Computers in Education Program for the secondary level. Through it, computers, software, training, and maintenance have been made available to almost all high schools in the country. The coordination of elementary and high-school programs generates new opportunities for students and ensures continuity of the efforts initiated with the younger children.

PEDAGOGICAL FOCUS AND SOCIAL CONTEXT

The Costa Rican Computers in Education Program was established to bring about change both in children and teachers, to promote interest in learning, and to develop technological fluency in schools and communities. Logo was chosen as a learning and exploration environment to stimulate creativity, cognitive development, and collaborative work. In 1998, LogoWriter, the initial program used, was replaced by MicroWorlds, a multimedia program consistent with the Logo philosophy and environment, which is used as a generic programming and educational tool. MicroWorlds² is the central software used, though other Microsoft productivity and reference programs are also used when relevant to educational objectives. Children's learning activities are project-based and curriculum-related. The development of computer literacy skills is seen as a valuable by-product of higher educational goals.

During the first decade, Seymour Papert and other members of the Learning and Epistemology Group of MIT's Media Lab have contributed to the program in the design of educational environments and teacher-training strategies. They have worked with ODF and Ministry of Education personnel. In order to provide a sound and practical understanding of the issues surrounding the use

2 In 1997, the Costa Rican Ministry of Education purchased a national license of MicroWorlds, thus making it possible for all students and teachers to have the software available in school, at home, and in other formal and informal learning and recreational environments.

of computers in education while enhancing the learning process, the ODF has promoted the academic and professional development of its teacher-training, research, and development staff. Historically, the foundation has invested significantly in the permanent training of all teachers and staff. This effort has had the support of the Ministry of Education and the University of Costa Rica.

The teacher, not the technology, has been the central focus of concern. Even though more than thirteen different options were considered during the planning phase back in 1987, the one selected was the most intensively teacher-dependent.³ This was so precisely because one of the main objectives of the program was to rekindle the teachers' interest in their own professional growth and to help them value their role as apprentices. It is interesting to note that when groups of young students have occasionally visited ODF's Training and Research Center, their greatest surprise has been to find teachers in the process of learning. As one kid put it: "Wow, I never knew teachers also have to study!"

Instead of bypassing the teacher through the use of technology, as has frequently been the case, the program chose to focus on teacher development by exploiting the potential of computers. For this purpose, a strong and systemic teacher-training and follow-up program was created (see Fonseca, 1993). The preparation of tutors who work as lab attendants has been conceived as a continuing education effort that transcends computer-related matters. Much time and effort have been devoted to aspects of educational philosophy and practice. Teacher development has been seen as a process that requires different types of pedagogical, motivational, and technical inputs at different times. This fundamental component has been the responsibility of a group of advisors — a well-prepared

3 For a detailed analysis of how the Program was created and of the central criteria for its success, see Clotilde Fonseca, *Computadoras en la Escuela Pública Costarricense: La Puesta en Marcha de una Decisión*. San José, Ediciones de la Fundación Omar Dengo, 1991.

and highly motivated permanent task force that is in charge of developing training materials and modules while providing on-site and, more recently, virtual or on-line support.

Every two years, a national Computers in Education Conference is organized by the ODF. The conference promotes the exchange of experiences while introducing participants to new ideas and initiatives of colleagues in other areas of the country. The conference and the different training programs are part of an effort to build a strong professional culture. In a new area such as educational computing, a different set of attitudes and behaviors is required for the new educational context. The program addresses the formation of this new culture through working not only with teachers, tutors and advisors, but with school principals, supervisors, and other educational authorities as well.

An important aspect related to teacher participation in the Costa Rican Computers in Education Program is the gender component. It is worthy of note that over 90 percent of the teachers working as tutors and 97 percent of advisors and program staff are women. Most of them had never had any prior experience with computer technology before joining the program. This is a telling fact. While it is true that in Costa Rica most teachers are women, the fact that mostly women have chosen to become computer tutors says much about the program's capacity to respond to different teachers' learning styles and sources of motivation. To most of these women, participating in the program has been an assertive act, which raised their self-esteem and their prestige within their local and professional communities. This undoubtedly creates non-traditional role models for the thousands of girls in the program.

Besides the different project-based and curriculum-related activities, other types of learning situations have become available for students and teachers. These provide

additional opportunities for enrichment, including access to themes, materials, and experiences not normally present in the traditional school setting or in often deprived community or home environments. Like the program that encompasses them, these new educational opportunities attempt to relate learning to personal productivity and to help children develop an awareness of the potential contributions they can make to their own communities.

Perhaps the most important of these activities is the Children's Computers in Education Conference. Created in 1989, the Children's Conference gathers several hundred K-6 elementary school students in an environment that is both recreational and educational. Children work throughout the school year on different research and creative development projects. Each school selects two delegates to the conference, who present their work and that of other classmates. They also participate in activities ranging from new design, telecommunications, and robotics workshops to cultural and recreational experiences.

The Children's Conference contributes to students' intellectual development while strengthening their personality and sense of autonomy. Kids travel, speak before a group, and express their own ideas and feelings. The selection of children to represent their school and present work produced by other classmates allows them to experience new forms of individual and group responsibility.

Like the program that hosts it, the conference provides low-income rural and inner city children from a small developing country with a variety of learning and socializing opportunities that combine play and cognitive skills, curriculum and community life, art and technology, personal interest and national values. Quite frequently, conference projects have a spill-over effect. Typical is the case of a group of children from San Isidro del General who, after having presented a project on deforestation, went back to their own town to organize a panel on ecological issues. These children were able to bring together to a

discussion table, not only the local authorities, but also owners of wood farms, many of whom had been responsible for deforestation in the area.

As recent research indicates, participation in the Children's Conference has a strong impact on the children's self-esteem and perception of their own future. A contest held by the foundation in 1997 collected the anecdotes of former program students, many of whom are now in high school or pursuing university careers. These stories revealed that the conference strongly affected the children's perception of themselves and their ability to plan a successful future. Many of them related how their participation in the program was a starting point for change in their lives.

These findings are consistent with what research on the program itself has revealed throughout the years. One of the primary effects of the program has been an improvement in the children's and the teachers' self-esteem and future outlook — an impact that was not anticipated but is central to individual growth and the capacity to learn. The program has also enhanced children's creativity (according to a 1993 Ministry of Education study), fostered children's independence, and increased their motivation to attend school.

THE SUBVERSIVE POWER OF COMPUTERS

Allowing children and teachers to develop their own talent and potential lies at the core of the Costa Rican Computers in Education Program. This, of course, can be a highly political matter. As a Latin American journalist who visited the program once noted: "If children learn to think as these kids are doing, if they become autonomous and critical, they may question the system, and that is dangerously subversive."

Few people have understood as deeply as this journalist the potential for innovative uses of computers in

education, particularly in the developing world. However, this inherent subversion is not the violent political activism to which many Latin American youngsters have been drawn for decades. It is rather the subversion of mental patterns that lie at the base of impoverishment and that keep human talent trapped for generations.

This fact was clearly understood by the principal of a poor rural school in Costa Rica, who chose to invest funds collected for a soccer field to prepare the facilities for a computer lab. "What these children really need, he noted, are soccer fields for the mind" (Fonseca, 1991, p. 54). This dynamic metaphor is right on target and highly consistent with the emphasis on the mind that characterizes most of the social and economic developments of the late 20th century. This is particularly the case in light of the work and power relations generated by the emerging information culture (Zuboff, 1988). Moreover, the skills and training that are demanded by current changes in industry increasingly call for symbolic analysts more than the routine producers that characterized the industrial age (Reich, 1992).

Computers cannot change certain human conditions; nor can they overcome certain limits. However, when placed within a context that is both humanistic and educationally enriching, they can help create change in schools and communities and in the lives of the children and teachers who inhabit them. Perhaps one of the more valuable contributions that the Computers in Elementary Education Program has made to the international community is showing that it is possible to obtain significant results from introducing new technological and educational opportunities to children and teachers from deprived communities.

The ten-year history of the Costa Rican program demonstrates that computers in schools and communities have a multifaceted potential to bring about changes, including unexpected ones. For this to happen, however, the

traditional linear view of change in education must be abandoned. To bring about systemic change in education, qualitatively new options and approaches must be sought. The energizing effect generated by the presence of computers in schools (*World Bank Report*, April 1998) must be used to improve the intellectual development and living conditions of people.

SOME REFLECTIONS ON TECHNOLOGY AND DEVELOPMENT

Within the wider scope of national development and after years of sustained effort and investment, Costa Rica has begun to see significant changes in the country's production, which has recently become highly technological. In 1987, when the ODF was created, the founders were convinced that investment in educational technology would have an impact on the country's socio-economic development. This was clearly reflected in the institution's constitutive documents. In 1992, many were still skeptical when some of us wrote that equitable access to the uses of technology to further educational goals could help launch a basically agricultural society towards a service-oriented information age society — i.e., new industries that are more productive and, hopefully, less taxing to the environment (Fonseca 1992).

Today the former skepticism has been overcome by new realities. Current trends point clearly in the direction initially envisioned to the point that Costa Rica is now referred to as the technological capital of Latin America.

Among the reasons cited for the selection of Costa Rica as investment site for the technology industry by such corporations as Acer, Intel, Microsoft, and Motorola were the presence of a national Computers in Education Program and the widespread use of computers. (After Canada and the U.S., Costa Rica is among the countries with the highest concentration of computers in the Western hemisphere — *Wall Street Journal Americas*, April 7, 1998.) All this indicates a certain level of education and technological

fluency in the general Costa Rican population. Coincidentally, on March 18, 1998, exactly ten years after the first elementary school computer lab was inaugurated, Intel began the operation of its microchip production plant — its first in all of Latin America.

OPTIMISTIC SCENARIOS

Experienced and somewhat skeptical experts and professionals in the field may view Costa Rica as a best-case scenario of the use of computers in schools and communities in the developing world. However, as Peter Schwartz has warned, optimistic views of the future are often viewed as unrealistic, which is a negative notion from a business point of view (*The Art of Long View*, 1991).

However, if countries genuinely wish to initiate change in education, they must abandon the tyranny of a linear view of development, which does not allow for the sudden leaps that can bring about qualitative changes. If attempting to do so is unrealistic, then so be it. Social systems undergo transformations as a result of the dialectical tension between the real and the possible, between the down-to-earth everyday reality and the dream. It has been said that the only sin we cannot forgive politicians and policy makers is their inability to dream, to envision new options.

INVESTING IN THE YOUNG

Why must we emphasize the politician's need to dream? Precisely because education has become a political matter. The need to invest in educating new generations is one of the central problems faced by governments and international organizations today. Education is no longer the sole concern of educators and parents, but is becoming a central issue to economists, manufacturers, and entrepreneurs. In a world increasingly preoccupied with economic globalization, issues of efficiency and productivity have

taken center stage, both in developed and developing countries.

But don't be misled by the economic reference implicit in the term "investment." A look at the etymology of the word is enlightening. "Investment" means empowering, granting control or authority, arraying the symbols of office or honor. To understand investments in educational technology strictly in terms of economic or quantitative returns is to overlook the higher social function of education. We must invest in the young, while investing in them the energizing power of the technological and cultural developments of their time.

REDEFINING PRIORITIES

To do this, however, we must redefine our priorities. The main argument used to justify the lack of investment in educational projects, particularly when associated with technology, is cost. However, funding problems are not exclusively economic problems. Deep down, they are political problems, because they involve the definition of priorities. The art or science of governing an organization, a community, or a nation is that of making choices.

This can be explained more clearly by way of an example: An F5 is a third-rate combat airplane whose use has been widespread in some Central American countries. In 1990 the cost of its yearly maintenance was approximately \$1.5 million. (Montoya, 1990). Costa Rica has invested less in the annual upkeep of its initial Computers in Education Program, to reach over 30 percent of elementary-school children throughout the country, than a neighboring country spent in the maintenance of *just one* of its fleet of 38 combat airplanes.

Even though funds allocated to military spending are always confidential and difficult to obtain, more recent figures based on data from specialized journals and sources can be even more illustrative. In 1996, the yearly

military budget of a neighboring Central American country was 75 million dollars.⁴ With that year's budget, it would have been possible to acquire 2,679 computer laboratories of 20 units each — a purchase that would have benefited over 3.5 million students or three times the elementary-school population of that country.

To provide an even more dramatic example, the cost of just one F16 airplane ranges from \$20 to \$25 million dollars.⁵ This sum would make it possible to purchase computers for nearly one million students. A major South American country is in the process of negotiating the purchase of 24 F16 combat airplanes, including training and spare parts. This involves an investment of about one billion dollars, an amount that would allow that country to provide access to computers in schools to 17 times their current elementary and high-school populations.

THE CONSTRUCTION OF THE FUTURE

A brief look at the political and economic situation around the world reveals that a significant proportion of the planet's population will remain unaffected by the dawn of the new millennium, no matter how momentous the change may be to others. Under such conditions the twenty-first century will reach very few people, if by twenty-first century we mean space-age development, quality of life, and access to the technological and social benefits of the time.

Furthermore, the impact that technology will have on our lives depends on social, political and economic decisions, not on the potential of the technology itself. Political and ethical decisions carry more influence than technological

4 Source: Military Balance, 1996/1997. These figures are provided for the sake of illustration and comparison. For this reason, the author has chosen not to reveal the name of the country in question.

5 Source: Council for a Livable World Education Fund based in Washington, D. C.

ones, because, as is historically evident, technological developments have not necessarily benefited everyone. Progress, as Paul Kennedy has observed, “benefits those groups or nations that are able to take advantage of the newer methods of science, just as it damages others that are less prepared, technologically, culturally and politically, to respond to change” (1993, p. 15).

Most of our challenges still lie precisely in the process of widespread cultural appropriation of the technology. We cannot refrain from facing these realities. Issues of equity and solidarity must regain their proper place so that our future will be characterized by actions more in line with our democratic values and global consciousness. Investing in the human aspects of development is no longer an altruistic matter. It is a matter of economic, national, and international survival.

THE NEED FOR VISION AND DIRECTION

Allowing children and teachers to emerge from behind their mental parapets — the limited confines of their cognitive and cultural windows — is one of the major changes that education must bring about. Creating learning environments that allow children to appropriate the world of knowledge — technology, science, art, — is more than a problem of pedagogical dimension; it is a problem of social policy, of risk taking, of tapping into situations that can nurture meaningful change. As Papert noted in *Mindstorms* almost two decades ago, “What is happening now is an empirical question. What can happen is a technical question, but what will happen is a political question, depending on social choices” (1980, p. 29). This is the key issue. Will technology continue to slip through the window of television, or will it become a door that opens the way to new opportunities and change?

Half a century ago, Costa Rica had a stubborn president who was a visionary. His name was Jose Figueres-Ferrer. He abolished the army and committed himself to the

construction of what could have easily been interpreted, within the context of the region and the times, as an “unrealistic scenario.” Because of its relation to the problems that concern us in rethinking the role of technology in education, I would like to close these remarks by quoting what he wrote in 1949, one year before he took that radical and path-breaking step:

First there should be a philosophy to light the way. Then come all the technical plans ... guided by a central idea and by the most noble spirit that we can snatch from our hearts. All of us know that stars cannot be reached by the hand. But we must agree that human beings, communities and nations need to know exactly the star to which they will hitch their wagon in order to be able to distinguish at crossroads along the way which paths lead forward, which are simply deviations, which will rather lead us back . . .

(Figueres, *Escritos y Discursos*, 1986)

No doubt the time has come to define precisely the star to which education will hitch the technology wagon.

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The Saint Paul Logo Project: An American Experience

*by Geraldine Kozberg
and Michael Tempel*

Geraldine Kozberg has been involved in issues of equity in public education for over 35 years, working as a teacher and administrator in St. Paul, Minnesota, and Boston, Massachusetts. The St. Paul Logo Project was one of the many staff development programs she initiated between 1981 and 1996 while she was Director of Staff Development for the St. Paul Public Schools.

Since 1986 she has been a volunteer with the Cambodian Children's Education Fund and is currently working with students and teachers at the Minneapolis Institute of Arts.

Michael Tempel is president of the Logo Foundation, a nonprofit organization devoted to providing information about Logo and support for Logo-using educators throughout the world.

He has also been an elementary school teacher and teacher-trainer in the New York City Public Schools, worked at the New York Academy of Sciences developing science education programs, and was Director of Educational Services with Logo Computer Systems, Inc.

Over the years he designed and implemented staff development programs for schools, schools districts, colleges and universities, ministries of education, and corporations throughout the world.



In 1980 Saint Paul Superintendent of Schools George Young asked Gerry Kozberg to conduct an evaluation of the computer education program in the Saint Paul Public Schools. Computer use was limited at the elementary school level to drill and practice software, while the few computer programming courses available at the secondary level had major inequities in the selection of students. Although these courses had no formal prerequisites, in practice completion of algebra was an entry requirement. As a result, most students in these classes were boys, with fewer minority students than in the school populations as a whole.

Determined to make computers accessible to all children, Gerry found a possible model in the Computers in Schools Project at the New York Academy of Sciences. This pioneer effort was a collaboration between the Academy, several New York City Public School Districts, Bank Street College, the Logo Group at the Massachusetts Institute of Technology, and Texas Instruments, Inc. Superintendent Young and Deputy Superintendent Kenneth Berg visited the New York Academy, where they were hosted by Executive Director Heinz Pagels, and New York City public schools, where prototype versions of Logo were being used by students and teachers. They also met Seymour Papert, who had been leading the MIT Logo group for 13 years.

The Computers in School Project provided extensive professional development, including Summer Institutes for teachers and regular on-site school visits. Teachers were encouraged to use computers in constructionist ways. Young and Berg came away from their visit determined to see the Saint Paul Public School system move in this direction with its own computer program.

The Saint Paul Logo project began in 1981 as one component of the aptly named Community/Schools Collaborative. Over the years many corporations, non-profit organizations, colleges, and universities came

together to further the development of Logo: The Saint Paul Companies, 3M, LEGO Dacta, Logo Computer Systems, Inc. (LCSI), Macalester College, Hamline University, The Massachusetts Institute of Technology, The Minnesota Museum of Science, and The Logo Foundation. Some of these collaborators, including Seymour Papert and the MIT Logo Group, were involved in the Computers in Schools Project. Michael Tempel, who had been Assistant Director of Educational Programs at the New York Academy of Sciences, joined the newly formed LCSI and worked with the Saint Paul project under new auspices.

The centerpiece of the collaboration was the Saint Paul Public Schools or, more precisely, the Staff Development Department of the school system under the leadership of Gerry Kozberg. For 17 years the Saint Paul Logo Project has provided a comprehensive program of teacher education in Logo practice and philosophy for hundreds of teachers in dozens of Saint Paul schools. The project has also been a collaboration in a larger sense, with scores of educators from around the world coming to Saint Paul to participate in our workshops, especially the intensive Logo Summer Institutes.

THE U.S. EDUCATIONAL SYSTEM

Some background on the educational system in the United States will provide a context for the work we have been doing in Saint Paul. Education in the U.S. is more decentralized than in most countries. Although a national Department of Education funds various programs, there is no Ministry of Education to determine curriculum, set standards for teachers, or administer the schools.

Instead, each of the 50 states sets its own standards and certifies its own teachers. The states also provide a portion of the funding for schools in their jurisdiction, but the actual administration and much of the funding rests in local school districts. These vary greatly in size from

rural districts of a single school to New York City with over 1000 schools, 60,000 teachers and more than 1,000,000 students.

Large cities in the U.S., including Saint Paul, generally have a higher proportion of children from poor families than in neighboring suburban districts. Because of local funding, usually through property taxes, the per pupil expenditure in suburban districts may be two to three times what it is in the city. This is reflected in higher teacher salaries, smaller classes that are better equipped and supplied, and well-maintained buildings. Rural districts also tend to be poor, but the vast majority of the population in the U.S. now lives in cities and suburbs. The inequity inherent in the local funding of schools based on property taxes has brought about legal challenges to the system across the country. This has resulted in some shifting of funding to the state level.

The Saint Paul Public School system with 69 schools, 45,000 students, and over 3,000 teachers is a “big city” school system. There are pockets of affluence, many working-class and middle-class neighborhoods, and many poor people. About half the students are from minority groups, including a large recent influx of immigrants from Southeast Asia.

In the U.S., decisions on the purchase and use of computers are made locally. Whether or not to use Logo is decided district by district, and in many places, including Saint Paul, this decision is left to individual schools.

STATE INFLUENCE

In spite of the decentralization of education in the U.S., some states have significant national influence. Texas and California have systems of statewide textbook adoption. That policy, combined with the large populations of these two states, carries considerable weight with publishers

and largely determines the textbooks that are available throughout the country.

Minnesota is not a large state, but with fewer than five million people, it has had a disproportionate influence on the development of educational technology. In the early 1980s the state-funded Minnesota Educational Computer Consortium (MECC) provided schools with software and support materials at a time when little was available for the computers that were just finding their way into schools. MECC initiated a licensing arrangement that was unique for that time. For an annual fee a school district would receive all the new software titles published by MECC that year. The district was then licensed to use them freely in all its schools. The appeal of this arrangement extended beyond Minnesota, with U.S. and international representatives attending the annual MECC conference in Minnesota. MECC has since been privatized and continues to publish and distribute educational software.

One of the teacher’s manuals written and distributed by MECC was about Apple Logo. MECC also published EZ Logo, a program that made it easier for very young children to work with Logo. Logo received another boost in 1986 when the Minnesota State Department of Education made mass purchases of a half dozen software applications for all the schools in the state. One of these was LogoWriter. Although there was no mandate to use LogoWriter or any of the other packages, the state endorsement encouraged schools to adopt LogoWriter and teachers to use it.

Without this state support, the Saint Paul Logo Project would have proceeded in essentially the same manner, but it did make things easier for us, especially in our outreach beyond the Saint Paul Public Schools themselves to other Minnesota districts.

TECHNOLOGY AND EDUCATION

Like most districts, the Saint Paul Public Schools has a department in charge of educational technology. Its role is to acquire computers, install them in schools, and then train teachers on how to use them. The Saint Paul Logo Project takes a different approach. The fact that it lies outside the educational technology mainstream allows it to keep a clear focus on learning and teaching rather than on hardware and software. In a study done in 1984, Peter Fire Dog of the University of Minnesota Sociology Department found that in the judgment of teachers, students working with Logo had improved performance in school and that the benefit was available to all children.¹

In her search for educational strategies and programs that would reach all children, Gerry Kozberg became convinced that Logo was the answer. The funding for teacher education and the computers themselves came through the Staff Development Department, allowing the program to maintain its independence and integrity.

THE STAFF DEVELOPMENT MODEL

The Saint Paul Logo Project has existed long enough to have witnessed dramatic changes in technology. We have grown and changed over the past 17 years. But the fundamentals of our staff development model have remained consistent.

We rely on a multifaceted approach, which has the Logo Summer Institute as its cornerstone. This week-long intensive workshop is the starting point for new teachers in the project and provides a periodic renewal for experienced teachers, some of whom have attended four or five Institutes over the years.

¹ Fire Dog, P., *Exciting effects of Logo in an urban public school system*. Educational Leadership, 1985. 43: p. 45-47.

It is also crucial to have sustaining activities during the school year. Brief follow-up workshops are held two or three times a year for the same group of people who attended the Summer Institute. In some schools an after-school workshop meets for two hours on a given day for a period of six or eight weeks. At various times support staff has been available for regular on-site visits to teachers participating in the project. Then there are the formal and informal mutual support systems that spring up in individual schools and in wider networks of schools. In order to encourage the growth of such support systems, one of the criteria we use in selecting schools for inclusion in the Logo Project is that several teachers from a school participate in the staff development program.

THE LOGO SUMMER INSTITUTE

Summer Institutes are not unique to the Saint Paul Logo Project or even to Logo. Many teachers spend parts of their summers immersing themselves in learning. It is important to get away from the day-to-day concerns and pressures of school and to spend some relaxed time focusing on larger issues and on one's own learning. In most years we have held two Institutes, in June and in August, in order to accommodate the large number of people wishing to attend.

An Institute begins on Monday morning when people arrive at the Board of Education headquarters with their computers, usually school equipment that they have taken home for the summer. We have a large conference room with tables and chairs arranged in clusters. It takes about an hour or so for all the computers to be set up. People who know how to do this help the novices. After coffee we gather for an introductory talk by Gerry. She relates the background of the Logo Project and tells the participants what to expect during the week and beyond into the school year. Michael opens the Logo Lab with a brief run-through of an introductory Logo project.

Michael and Gerry are joined by other facilitators. For the past several years a stable group of three people have fulfilled this role: Darrell Mohrhauser, a science teacher at Como Senior High School; Kathy Ames, the computer teacher at Battle Creek Elementary School; and Ron Beck, a sixth grade teacher at St. Anthony Park Elementary School. Because of the differences in their backgrounds and teaching assignments, they bring a wide range of experience and expertise to the workshop.

After the introduction people get started with Logo, working on their own or in self-formed groups. We ask the more experienced people to help out for a while until the novices get started. By the end of the morning there are no more novices.

The introductory project is generally based on the documentation that accompanies the software that most people are using. Since the early 1990s the choice of the Saint Paul schools has been MicroWorlds and before that LogoWriter. The open-ended project approach of the materials that are packaged with these versions of Logo is in keeping with our view of learning and teaching.

This initial project is usually an illustrated, animated story or a report. It is designed to give people an overview of the major features and capabilities of the Logo environment. With MicroWorlds this includes using the drawing tools, writing text, and using turtles as characters in an animated sequence. We introduce Logo programming as needed, usually when someone wants to control an animated character.

Participants who have been using Logo for a while with students usually have some idea of the kinds of projects they want to work on. They may have activities from the previous school year that they want to develop or some new ideas to try out. We also provide a range of project ideas and activities for people who are looking for new inspiration.

By far the most common kind of project is the multimedia story or report. This began many years ago and has flourished with the introduction of MicroWorlds. People combine drawings, written descriptions, images that have been scanned or taken from CDs and the Internet, recorded sounds, and music into elaborate creations.

Among the varied topics are travelogues like Amy Woods' retelling of her trip to the Atlantic provinces of Canada or Jeanne Walker's Bermuda project. One year, when we had many participants from Minnesota school districts outside Saint Paul, a large group project combined many smaller projects into a Minnesota travelogue. These are most common during the August Institutes when people are just back from their vacations.

We've also seen many social studies reports. Patricia Loosli presented the history and geography of her native Chile. Teachers have done projects centering on the local history of their school neighborhoods. Also popular are fictional stories, either the retelling of a familiar fairy tale or Mother Goose rhyme, or original creations.

If the focus is creating multimedia reports and stories, why use the Logo environment of MicroWorlds when HyperStudio would be a good choice? Because the creation of these projects involves problem solving, debugging, and mathematical thinking. Programming a car to accelerate across the screen puts one in touch with the laws of physics in a way that cannot be matched by simply dragging the car and having the computer record the move. We also want to establish that computers are controlled by people, not the other way around. Programming is the way that people control computers.

The advantage of having a Logo-based multimedia environment becomes clear when people move from presenting information to creating simulations. Chuck Smith programmed an environment populated by cows. He could set the values of various parameters, such as availability of food and the amount of sunlight, and then let the cows

loose to feed, grow, reproduce, and die. Diane Jackson from Australia attempted a similar simulation with kangaroos. Gary McCallister, a biology professor, simulated the growth and control of a mosquito population.

In the early days most people were introduced to Logo through turtle geometry, using the turtle to create geometric shapes, patterns, and representational drawings. Some educators feel that the inclusion of drawing tools in MicroWorlds has undermined this very valuable area of exploration and learning. We don't agree. It is true that people today rarely use the turtle to draw houses, backgrounds, and people. Instead, they use the drawing tools and the Shapes Center. We don't feel that this is a loss. Creating an elaborate scene with the turtle is very time-consuming. While there is certainly problem solving and debugging involved, the experience is often not very deep.

The Minnesota travelogue mentioned above was done many years ago using LogoWriter. Two teachers spent the better part of a morning drawing a map of Minnesota with a sequence of Forward, Right, and Left commands. Today they would just scan the map or load it from a CD. The time saved would then be devoted to creating a more elaborate project in which programming would very likely be used in other ways.

People are still engaged by turtle geometry, which has not lost its impact or appeal. While it is not as central to our workshops as it used to be, many people still spend time exploring with the turtle. A few even become immersed in it. Olga Vilanova spent a week exploring geometric patterns and the use of variables in the Logo programs that drew them. Charles Lee elaborated on the idea of recursive tree designs to build a program that included a bit of randomness so that it drew a different forest each time it was run.

Another very popular area of Logo programming is video games, including adventure games, mazes, and shoot-em-up type action games. MicroWorlds is more appropriate

for some kinds of games than others. Sports games with their 3D perspective and fast pace are hard to match, but one can make a very respectable adventure game in the spirit of Myst. Children and adults alike accept the limitations and are satisfied because what they have built is their own.

Logo also connects to the world outside the computer. Logo programs can use information gathered from the outside world through sensors, and activate motors and lights that are built into devices constructed out of LEGO elements. LEGO Logo became a major activity at Galtier Magnet School, where Paul Krocheski worked with students and teachers to develop many original projects. Kathy Ames at Battle Creek Elementary School and Ron Beck at St. Anthony Park Elementary school have also made extensive use of LEGO Logo in their schools. An exhibit of student projects was held at the Minnesota Museum of Science, an institution that has offered Logo and LEGO Logo courses and workshops for teachers and students. The Museum currently has a web site where children's MicroWorlds projects are posted².

When LEGO Logo became available in the mid-1980s, we introduced it in our Summer Institutes. But we found that it was difficult to include without having it take over the Institute. When we presented it on Thursday, people would be torn between continuing their other Logo projects and switching to LEGO Logo. The logistics and room setup are also very different for a LEGO Logo workshop. Fewer computers are needed, but more open space.

We eventually decided to organize separate sessions for LEGO Logo, generally as a follow-up workshop during the school year. This approach gives LEGO Logo the time and attention it needs and has the additional advantage of making sure that people have a solid grounding in Logo before they begin with LEGO Logo. Without this

² <http://www.greatestplaces.org/games/>

background, the full potential of LEGO Logo may not be appreciated, and it is easy, especially with the newer Control Lab™, to rely on the point-and-click aspects of the software at the expense of programming.

MODELING TEACHING AND LEARNING

The Summer Institutes provide a solid background in Logo programming and techniques. Teachers are prepared to use this experience to work with their students. But we are doing much more. We are modeling a constructionist way of learning and teaching, while setting up learning environments where these can take place. First of all, there is plenty of uninterrupted time as well as ample access to computers and software. We always provide at least one computer per person. Participants move around, interacting with one another and the facilitators. Very quickly, the projects take root, with varying levels of complexity and areas of interest. We encourage people to develop projects that are personally meaningful to them.

Rather than tracking or ability grouping, learners of all levels of Logo experience are grouped together. Groups are formed as needed to address areas of interest or teach skills when several people are looking for the same thing. Otherwise, assistance and instruction are individualized. We encourage participants to seek help from one another. A question may be answered with “Amy over there just did that. Why don’t you go take a look and ask her about it?” The participants realize that the facilitators are not all-knowing but are often stumped by problems. They see each of us sometimes call on someone else for help: “Can you see what’s wrong here? I can’t get it.” We are comfortable saying “I don’t know” since we have the strategies to find the answers.

Many teachers find this model difficult to accept themselves and to follow in their schools. They may see students for only one or two periods per week. In self-contained elementary-school classrooms time is more flexible,

but computers may be few and the teacher’s attention may be pulled towards other activities. Many teachers have a deep-seated feeling that they must always know everything and always be fully in charge. Still, many teachers want and are able to work with students in constructionist ways. The kinds of projects that the children develop during the school year turn out to be very similar to those the teachers build during the Summer Institute.

The topic may be insects or the history of the school’s neighborhood. One could create a multimedia report, learning about the subject matter, Logo skills, and MicroWorlds techniques in the process. With this background, teachers could then encourage their students to build similar projects. They could begin the new school year by showing off their own projects to the class. This is a very powerful approach that lets the students see their teachers as learners.

While many Institute participants do this, others stand these projects on their heads. Every Institute has teachers who use Logo to create instructionist software. Instead of a report on insects or a neighborhood history, they write a quiz. The teacher has had a constructionist experience making drill-and-practice software, but the students’ experience will be very different.

This may seem like the natural thing to do. How do the facilitators react? We raise the issue, just as we are doing here, and suggest alternatives. When someone is devoting so much time and effort to building a project, we don’t want to simply say that it is all wrong. But what if we take this stood-on-its-head Logo project and flip it one more time? Instead of using it as instructionist software, present it to the children as a model of what they could do. They can then write quizzes of their own.

DIALOG AND DISCUSSION

Around 80 percent of the time spent at a Summer Institute is devoted to Logo Lab. This kind of learning requires a lot of time. But it is also important to place this Logo learning in a larger educational and social context. One way we do this is through dialog groups.

A dialog is different from a discussion, as explained by Peter Senge³. We ask people to read this chapter before joining the Institute. A dialog encourages a free exchange of ideas without the pressure to convince others or arrive at a conclusion.

The dialogs are held on three days for about an hour each time. Readings are designed to set a framework for the dialog, but the goal is not to discuss the readings. Each year the collection is different. We have used chapters from each of Seymour Papert's three books, *Mindstorms*, *The Children's Machine*, and *The Connected Family*.⁴ We've also included futurist writings by Alvin Toffler⁵ and Nicholas Negraponte⁶, as well as articles about educational trends and developments that are relevant to how we teach and learn Logo.

A case in point is TESA (Teacher Expectations Student Achievement). This staff development program is based on research that shows how dramatically our expectations of students affect their performance.⁷ Over the years it

3 "The Discipline of Team Learning, Dialog and Discussion" from *The Fifth Discipline, The Art and Practice of the Learning Organization* by Peter Senge, Doubleday, 1990.

4 Papert, Seymour: *Mindstorms*, Basic Books, New York, 1981. *The Children's Machine*, Basic Books, New York, 1993. *The Connected Family*, Longstreet Press, Marietta, GA, 1996.

5 *Future Shock*, Bantam Books, NY 1991.

6 *Being Digital*, Alfred A. Knopf, New York, 1995.

7 Good, Thomas L., "Teacher Expectations and Student Perceptions: A Decade of Research," *Educational Leadership*, February, 1981.

seemed to us that teachers in Logo environments tend to have more open expectations and fewer preconceived notions about their students. We also think that the positive effects of working with Logo that were shown in Peter Fire Dog's research are mediated through the expectations of teachers. This has been an important dialog topic.

But teachers must make concrete plans for implementing their Logo experience in their schools. To include this as a topic for discussion, we have organized planning discussions in various ways. Sometimes we set aside time slots during the week to pull together groups arranged by school, grade level, or subject. In other years we have taken a less formal approach, suggesting that these discussions continue during the lunch break, which has been stretched to 90 minutes to allow time for this to occur.

OTHER APPROACHES

One year we decided to try a more formal approach to provide background in disciplines related to our work as teachers. Two Macalester College professors each gave a series of lectures: Chuck Green in political science and Walter Mink in cognitive science.

During another Institute we decided to go out in the world looking for "Logo-like thinking," whatever that might mean. We split into small groups. Some went to 3M and other local corporate offices. Others had appointments at labs and offices at the University of Minnesota. A few of us went downtown to see what we could find by wandering around. After a couple of hours we came up dry and went to the landmark Mickey's Diner for coffee. We watched the cook while she juggled as many as four or five orders on the grill at the same time. We'd found what we were looking for. Here was procedural thinking and parallel processing in a real-life situation. The other groups did not do as well in finding a comparable example.

Then there are our extracurricular activities: the Minnesota State Fair, which usually coincides with the August Institute, and the annual barbecue hosted by Kathy Ames for the out-of-town participants. Baseball fans can also watch the minor league Saint Paul Saints.

VISITORS ARE WELCOME

The Logo Summer Institutes are not just for Saint Paul teachers. We include as many as a dozen outsiders in a group of 25 to 30 people. A creative tension between the two of us has always existed over this issue, with Gerry wanting to focus on Saint Paul and Michael wanting to extend the project's influence to the world. But the balance has been a good one. Since the majority of participants are from the Saint Paul Public Schools, the Institute maintains a focus on the Saint Paul Logo Project. The outsiders benefit from gaining experience with this model project, while they enrich the Institutes with their variety of experiences. Diversity is a good thing.

Most of the outsiders are teachers from other school districts. They discover the Institute through *Logo Update*, the Logo Foundation newsletter, the Logo Foundation web site⁸, or word of mouth. Often a district will send several teachers to an Institute, sometimes over a period of years. We have had regulars from Delhi, Iowa, and Chicago Lakes, Minnesota. Districts with major Logo projects of their own — Bellevue, Washington; Ladue, Missouri; Lubbock, Texas; and the Omar Dengo Foundation in Costa Rica — have also sent teachers and administrators to the Institutes.

Some people, not all of whom are classroom teachers, come on their own. College professors have included biology professor Gary McCallister, who then inspired his colleagues in Colorado to start their own Logo Summer

Institutes. We have also had several home schoolers and a graphic artist with a personal interest in Logo.

For several years we had a group of engineers from 3M, a major corporation with headquarters and other facilities around the Twin Cities area. These volunteers attended the Summer Institutes and then worked with children in classrooms where Logo was being taught.

In 1986, when the State Education Department purchased LogoWriter licenses for all Minnesota public schools, the Saint Paul Logo Project was called upon to provide staff development services in Logo. This included a brief introductory workshop for the personnel of regional training centers, attendance at our Summer Institutes, and follow-up workshops by teachers from across the state.

In 1988 and 1989 we made presentations and offered workshops at the annual spring conference of the Minnesota Educational Effectiveness Program (MEEP), an organization that mostly serves educators from the smaller cities and rural areas outside the Twin Cities. At the 1989 conference Seymour Papert gave the keynote address. We were somewhat overwhelmed by MEEP. There are so many MEEPers that they have two annual conferences back-to-back: one from Monday morning through noon Wednesday and a rerun from Wednesday afternoon through Friday. Fifteen hundred people attended each conference.

Two of the Minnesota State Techmobiles were also at the conferences. These buses, stripped of regular seats and equipped with 10 computers, served the rural areas of the state, where they were used for workshops. They parked at Madden's, the Brainerd resort and conference center where the MEEP events were held. We used them to conduct an ongoing series of short Logo workshops for five consecutive days.

⁸ <http://el.www.media.mit.edu/logo-foundation/>

SUMMER'S OVER

People leave the Summer Institute with wonderful plans and intentions for the school year. They must be supported in order to follow through effectively. We provide this support in several ways. Two or three times during the school year we schedule short follow-up workshops. A very successful format has been to begin with a 4 PM to 8 PM session on a Thursday evening, including a light supper, followed by a full day on Friday. Instead of using the Board of Education headquarters, we hold these sessions in one of the schools. This requires freeing a computer room or library for the day, but staff and administrators are generally happy to cooperate.

The topics for these workshops vary. The fall session has usually been devoted to LEGO Logo. The second workshop is on a specific Logo topic, such as game programming or Logo and mathematics. The last workshop in the spring is devoted to assessing and extending students' work. Teachers bring samples of children's projects to share. We then discuss them and look at how to proceed from there.

Another follow-up modality is a regular weekly after-school workshop that meets for a six-week period. Kathy Ames has done this frequently for the teachers at Battle Creek Elementary School. Here the focus is on a single school rather than the Summer Institute group as a whole.

At times funding has been available for a full-time support person. For several years Mike Hopkins provided on-site support for the teachers in the project, visiting each school regularly and tailoring his activities to the needs of the students and teachers.

For a while, during the late 1980s, a local electronic bulletin board provided a virtual support group for those teachers who took advantage of it. John Olson, who taught at Murray Junior High School, set up the bulletin board using LogoExpress, a system that was both ahead of its time and behind the times. It was easy to set up and maintain, and ran comfortably in an Apple II computer. One could transmit not only text messages, but complete LogoWriter pages. It is now routine for e-mail to carry "attachments" of any file format, but at that time this was uncommon, which made it a major advantage of LogoExpress. On the other hand, LogoExpress bulletin boards were isolated. As the Internet grew, LogoExpress, along with other simple local boards, faded away.

TECHNOLOGICAL CHANGE

The inundation of LogoExpress by the Internet is just one of the technological changes that the Saint Paul Logo Project has adjusted to. In our first workshops we used Apple Logo. Most of the projects involved drawing with the turtle. Our first taste of animation came in 1983 with Sprite Logo. LogoWriter and LEGO Logo were introduced in 1985 and MicroWorlds in 1992.

The Saint Paul Logo Project has always been on the leading edge of technology. This is largely due to our collaboration with the Massachusetts Institute of Technology, Logo Computer Systems, Inc., the developer of all the versions of Logo used in the project, and the Logo Foundation. New LCSI software developments were generally brought to Saint Paul before they were available to the general public. Prototype systems from MIT, such as the Programmable Brick, also enhanced our workshops.

Right now we are moving towards an era when all computers will be connected to the Internet. Sharing of projects and accessing resources are undergoing fundamental transformations. Some of the Saint Paul Schools have already networked computers with full-time Internet access. Others are still working with stand-alone systems in isolated classrooms.

Our Summer Institute logistics will change so as to provide for networking among the participants' machines and onto the Internet itself. We have held some of our workshops at St. Anthony Park Elementary School rather than the Board of Education headquarters, because the school is connected to the Internet.

These technological changes have resulted in more user-friendly environments where more people can find a level of comfort. Less time is devoted to the mechanics of file management, printing, and keeping things working. More time is devoted to thinking and learning. But the fundamentals do not change. We still use Logo as a constructionist learning environment.

IN THE SCHOOLS

Over the years hundreds of teachers have been involved in the Saint Paul Logo project. What has happened in their schools? In the classrooms and computer rooms we saw projects that were similar to those modeled during the workshops, with the level of complexity and sophistication, both in terms of Logo and the presentation of subject matter, varying with age and grade level. Logo did not take hold in all schools however. A number of factors have contributed to its acceptance and use.

In most schools where Logo has had a strong presence there has been at least one teacher who has taken the lead, offering expertise and providing encouragement and support. In some cases this has been the computer teacher: John Olson at Murray Junior High School, Charlotte Coan at Dayton's Bluff Elementary School, Paul Krocheski at Galtier Magnet school, and Kathy Ames at Battle Creek Middle School.

But often a regular classroom teacher has mentored other teachers, such as Ardyce Erlich, an English teacher at Humbolt Junior High School, and Jeanne Walker, a mathematics teacher at Highland Park Junior High School. Sometimes only a few teachers are involved with Logo, but Ron Beck, a sixth grade teacher at St. Anthony Park Elementary School, has managed to engage most of his colleagues. The school has a computer room, as well as computers in classrooms, but no computer teacher. Teachers bring their students to the computer room and remain to work with them. Ron maintains the computer room and provides technical support for other teachers, but they do the teaching.

In some schools collaborative groups have emerged with a number of teachers working together to support one another in their Logo work. At Como Senior High School teachers of art, science and English as a second language (ESL) work with Logo. Nearly all the teachers at the Adams Spanish Immersion School have used both English and Spanish versions of LogoWriter and now MicroWorlds. Logo has also been widely accepted in the Saint Paul district's two Montessori schools.

In some cases individual teachers work largely on their own. Judy Ronei teaches a self-contained fifth grade class at Mann Elementary School. For years she had one computer in her classroom that was constantly running Logo

or LEGO Logo. Occasionally her work took center stage at the school, as when Middle Ages Expo, held for the entire school, took over the gym for a week. Different classes put up displays of their creations relating to the theme of the Middle Ages, with stories, drawings, and constructions of all kinds. Judy's own class used Logo to develop an interactive quiz about medieval history for visiting parents. Another display was of computer-controlled jousting knights built out of LEGO Logo.

Helen Kraft's first graders studied animals. In their Logo Animals⁹ project they used Logo to draw animals and the text-processing component of LogoWriter to describe them. Helen provided a collection of tool procedures to make their project development more efficient and satisfying. Geometry learning was also added to the project, with four sizes of three geometric shapes: circles, squares, and triangles. An interesting aspect of this work is that most of the students were not reading when they began the project, but through it they learned to write.

Enthusiastic teachers and a good support system form only part of the picture. The school principal has a significant effect on how much and how well Logo is used in a school. Some principals support their teachers by recommending that they attend the Summer Institutes and by providing for released time and after-school workshops. The widespread use of Logo at St. Anthony Park is due in part to the enthusiasm of principal Tom Foster. Luz Serano has also given Logo a big boost at Adams.

Administrative support enables enthusiastic teachers to thrive in many concrete ways. At Galtier Magnet School classes were scheduled in the computer room with regular teachers and the computer specialist at the same time.

Although double staffing might seem inefficient to many administrators, it is a good way to encourage the classroom teacher to take ownership of the Logo program and to sustain it in the classroom. Administrators may also find money for software and equipment and arrange released time for teachers to attend workshops. More generally, they can set a tone of approval and encouragement for a program, which motivates teachers to pursue it.

Occasionally a principal goes a bit further. Kate Anderson "mandated" Logo for all teachers at Dayton's Bluff. Although unclear on exactly what this meant, we immediately agreed when she approached us to introduce Logo to her staff. She asked us to do three sessions of an hour and a half each. The entire staff, — teachers, aides, the librarian, lunchroom people, and the custodian — rotated through these three sessions. This seemed like the worst possible format: sessions that were too brief with groups that were too big and no provision for hands-on experience with Logo. But somehow it worked. We were enthusiastically received and Logo went into high gear. It would not have been sustained without Charlotte Coan who worked with students of all grade levels in her computer room. She came to many Summer Institutes and follow-up workshops with piles of disks and printouts of her students' work.

Kate Anderson left Dayton's Bluff to go to another school, where she also "mandated" Logo and encouraged more teachers to join the Saint Paul Logo Project. Charlotte Coan continued to teach Logo at Dayton's Bluff until she retired last year. At that point the computer room was turned over to an instructional learning system (ILS) and Logo was eliminated.

⁹ Kraft, Helen. *Logo Animals*, 1991, <http://el.www.media.mit.edu/logo-foundation/papers/>

Logo has found a place in many Saint Paul schools for varying periods of time. We have changed some schools and affected hundreds of teachers and thousands of students. But we have not changed the underlying school culture, which is mostly out of tune with constructionist ways of teaching and learning, even though three superintendents fiercely supported Logo for over 18 years. When there is the right mix of enthusiastic administrators, teachers, and sometimes parents, Logo thrives. Often when those individuals move on, so does Logo.

The experience at Dayton's Bluff is now being mirrored and magnified in the Saint Paul Public Schools as a whole. Gerry Kozberg retired in the summer of 1997. The new administrator, whose responsibilities include the Logo Project, has focused all her efforts on program and staff development that impact student achievement as measured by standardized tests. Logo does not fit that agenda. This administrative change did not come as a surprise. We fully expected that without Gerry the project would at best be under pressure and that its support by the central administration might not continue.

But this is not a story with a sad ending. Teachers and children still use Logo, and we had other plans in place. Remember that the original name of the project was the Community Schools Collaborative. The importance of the collaborative aspect becomes very clear as two other partners, the Logo Foundation and Hamline University, plan the next series of Summer Institutes and carry the project forward in new ways for teachers in the Saint Paul Public Schools and in other districts in the Twin Cities area.

In a broader sense the Saint Paul Logo Project has already established permanence by continuing in other places. During the summer of 1998 the Logo Foundation is cosponsoring Summer Institutes with the Spence School in New York City and Mesa State College in Colorado.

The staff development model we developed in Saint Paul is followed in these Institutes and in the many others that the Logo Foundation has sponsored over the years. Like computers themselves, the Saint Paul Logo Project is no longer rooted in a specific geographic location. Our "computer" is now the World Wide Web, not just the machine sitting in front of us. The Saint Paul Logo Project has evolved into a collection of Summer Institutes, workshops and Internet-based support activities that have educators using Logo around the world.



The Russian School System and the Logo Approach: Two Methods Worlds Apart

*by Sergei Soprunov
and Elena Yakovleva*



Sergei Soprunov has led the Logo Group of the Institute of New Technologies of Education (INT) since its founding. He was involved in the localization of LogoWriter and MicroWorlds in Russian, Czech, Korean, and Lithuanian, and is presently developing IconLogo. He has been a part-time computer teacher at Moscow school #57 since 1989.

Elena Yakovleva has been involved in the field of Computers in Education since 1989. She is a Project Director in the National Geographic Kids Network and a teacher's trainer and consultant for the Logo Group of INT.

Dr. Soprunov and Ms. Yakovleva were instrumental in initiating the Russian Logo community. They have published, separately and together, several Logo books for teachers.



In order to understand how the introduction of Logo into Russia took place, it is necessary to analyze the traditional Russian system of education. First, try to imagine 1.5 to 2 million eleven-year-old boys in identical suits and the same number of girls in identical dresses, all reading the same paragraph in identical textbooks. Now, replicate this picture tenfold with the appropriate coefficients of enlargement or reduction and you are looking at Soviet schools grades 1 through 10, albeit in a somewhat comic fashion.

Which aspects of the educational system could one call opposite to the child centered approach? The strict structure, the unified, predetermined program, these were trademarks of the Russian school system. In the Soviet Union all schools, excluding a small number of specialized ones, were subject to a single common educational plan. Every teacher was assigned to “cover” certain material by a certain week, using the same textbook in every corner of the country and complying with the methods prescribed by the “higher up” educational bureaucracy.

The spirit of unity that ruled the schools was well-suited by the identical uniforms, worn from freezing Yakutia to hot Turkmenia. It was also supported by the required membership of every child in the junior political organizations, and the formal, semi-military “entertainment” provided by these organizations, such as “lining up and singing patriotic songs” and ideologically oriented “spontaneous” gatherings.

The idea of an individual approach rarely occurred to the teachers constrained from all sides. What could they do while carrying on with the strictly regulated progression of lessons? Possibly, they would give a challenging problem to an advanced student or spend an extra hour with one who had fallen behind.

Despite all this, educated people were highly valued by Soviet society. A quote from a movie of those times reads “Parents married their daughters to physicists without

asking about their salaries.” There was a number of special schools (spets-shkola) where a particular subject was studied in greater depth. Often times, university professors actively participated in teaching in these schools. Admission to these places, as well as to technical schools in higher education, was very competitive.

Another distinction of Russian education is its famous emphasis towards the natural sciences and academics. Children were brought up to become scientists. The methods of scientific research, the ability to use maps, and the work with dictionaries and reference literature were a central part of the educational plan. Emphasis was placed on understanding abstract, theoretical concepts. Not that the practical aspects were ignored; rather, they played a secondary, often illustrative role. Of course, experiments were conducted in physics and chemistry classes, and there were even special classes of practice, Technical Training for boys and Housekeeping for girls. However, even in these classes, before starting to use a sewing machine, one would be first required to learn in detail the principles of operation of the sewing machine and the technical parameters of the types of threads out of which fabrics are made (the difference between viscose and acetate silk), as well as the general principles of making patterns.

One must note that, all in all, this approach reached its goal. The school, as a rule, succeeded in promoting the students’ sometimes deep understanding of such concepts as mathematical proof, logical reasoning, and the ideas of classification and analysis of data. This was true not only in the natural sciences but in the humanities as well.

To demonstrate the depth of the effects of this scientific approach, I recall an anecdotal example from my own experience. In 1988, one of my friends offered to “teach me” how to use a computer (naturally, without one at hand). I immediately imagined that, for a start, I would need to learn precisely how these computers function,

that is to master the mysterious subject of electronics. Unfortunately, my friend began his lesson with a description of the tree-like structure of the file system. With my college education I immediately added the theory of graphs to my list of prerequisites, and was ready to forget about the idea of getting acquainted with computers completely.

A singer (Boris Grebenshikov) rather popular in my generation for his thoughts, apparently, feeling the same, wrote, “If only I knew, what electricity is, if only I knew, how the sound travels, I could call you on the phone...”

When the computer first appeared in Soviet schools, it fit into the system relatively harmoniously. Educators who worked on promoting the computer saw it, first of all, as an object of computer science, the science related to such important mathematical concepts as numerical systems, algorithms, and complexity of computations.

Nowadays such a position would seem paradoxical: the computer, which is presently viewed as a practical instrument, was, at the time, primarily considered an object of theoretical study.

INFORMATICS THE SOVIET WAY

In the early 80’s, the government announced that the Soviet Union lagged behind the United States, Japan, and the other Western European countries in developing and applying information technology in industry, management, and education. In order to improve the situation, the government made a bold decision: it decreed the introduction of a new subject, “informatics,” into the uniform, rigid curriculum of all high schools across the country. It was a truly unprecedented step for no other subject had been added to the curriculum since its inception in the mid 1920’s. Even then, the subjects were identical to the pre-Revolutionary ones, except that the Doctrine of Scientific Communism replaced God’s Law.

As we said earlier, originally, the word “informatics” implied something similar to information technology or computer science. In reality, it often reduced to an elementary course on general principles of programming, presented in the most abstract fashion, uninviting to all but a few computer addicts. Textbooks were written with no attempt to make the subject more attractive or interesting to an average student.

On the other hand, in spite of the absence of special pedagogical training and of a centralized curriculum, the majority of teachers had a solid idea about the role of computers in schools. They viewed computers as a tool for teaching programming or as an instrument for developing the children’s algorithmic and logical thinking. They did have a point, since computers, as we mentioned earlier, are closely related to these concepts and skills.

Many educators turned out to be capable of explaining or at least conveying an idea of what good programming is, because they themselves were professional programmers. In the Soviet Union it was difficult to find a person who worked with computers but was not a computer programmer to some extent. In the same way as it was difficult to find a driver who was not a skilled mechanic.

Back then, foreign software, especially localized versions of it, was not used in schools. A reason for this was that the popular user programs such as word-processors and databases were considered superficial, while software aimed at education was unknown.

Also, in those years, only verbs like “get hold of” or “find” were used in relation to obtaining software in our country, but never the verb “buy”. This was almost a linguistic phenomenon. The only legal usage of foreign software known to us was the case when Alexander Shen, a teacher of Moscow School #57, convinced the representative of Borland at a computer show to give Pascal to the school for free.

Naturally, the most widely used software in schools were programming languages such as Basic and Pascal. These often lacked proper documentation and description. Russian software aimed at teaching algorithms and programming such as MicroMir, Algoritmica, and Robotlandia were also common. Besides being written specifically for teaching, these had the additional advantage of taking into account the specifics of the Russian educational system.

Unfortunately, except for a select few, no secondary school in this country (there were about 100,000 of them) was provided with computers to run the programs that the students were supposed to write. Special informatics centers were established in some big cities, but not in the small towns and villages where half of the population resided. Thus, once a week (or once a fortnight, or once a month) the students of a particular school would take a field trip to such a center to operate the computers and run the programs written beforehand. Most of the time, however, the students would simply watch while this work was done by instructors. E-mail and inter-school computer networks did not exist. All that we have said so far could lead the reader to think that informatics in schools during this period was a dull, tiresome and tedious subject. Maybe so, but students liked it nevertheless. Between a Russian and a geometry class, informatics entertained just as a physical education or a technical training class.

1987 - 1995: ENTER LogoWRITER

Naturally, many teachers and educators considered the situation in education unsatisfactory, feeling the incompatibility of the uniform, rigid system with the rapidly progressing world. The beginning of radical changes in Russia during the “Perestroika” years stimulated the transition from the vague understanding that a different sort of education could be more effective to searching for

practical solutions. Possibly, under other circumstances, the dissatisfaction of the people involved in education with the “what and how” of the teaching process would have remained unrealized or would have led to insignificant changes. Perestroika, which shook up absolutely all aspects of life of Soviet society, helped to turn the hidden yearning for change into energetic attempts to reorganize even such a conservative institution as education.

One must note that at the time, a “scale of values” had not yet been developed to assess how productive a particular idea was or how radical certain changes were. Thus various ideas were brought to life, some completely insane and some that later proved to be quite useful.

The people concerned with the condition of education and who believed in both the necessity and possibility of positive changes included not only professional educators, but also a substantial number of respected scientists and public figures. In 1984, a temporary science and technology team was formed under the Academy of Sciences to develop a project named “School-I.” The main task of “School” was the development and introduction of new ideas and methods related to using new technology in school education. Later, in 1989, this group transformed into the Institute of New Technology in Education (INT).

In practice, “School” was in charge of many affairs that concerned the educational institutions which formed the alternative to “official” education. These institutions were regular schools which declared their desire to reorganize the teaching process under new principles, as well as many organizations outside of the school system, that offered extra-curricular education, such as youth clubs. Many of these clubs were related to computers. One of the first computer clubs in Moscow, club “Computer,” created by the combined efforts of the “School” project and the chess world champion, Gary Kasparov, exists and functions to this day. Characteristically, the range of the club’s activities, which at the beginning was restricted to

using computers, has significantly shifted, and is currently composed of projects such as organization of a lycee of “complementary education” that besides computer programming teaches linguistics, economics and youth journalism.

One of the most important and efficient types of support was the establishment of contacts with foreign educational organizations. These were mostly American schools and universities as well as such large organizations as TERC and NGS. Naturally, the types of contacts also varied from simple meetings of teachers, exchanges and correspondence to joint educational projects, such as Global Lab and National Geographic Kids Network.

Other people’s experiences were thought-provoking for the teachers: “How can this be called teaching?” or “Show me what these kids learned?”. Then there were responses like this one: “For me your proposal to participate in this project (Kids Network) is like a proposal to take my class on an excursion to Mars”.

On the whole, however, international contacts served as groundwork for future changes rather than leading to immediate imitation. An important result of meetings, discussions and correspondence with foreign colleagues was that Russian teachers could see that there was choice. The results could be intriguing or completely unacceptable, but along the way the “theorem of existence” of different educational approaches was being proved in practice. This created the feeling that giving free rein to one’s thoughts and ideas could be quite productive.

Note that most of the projects that are flourishing to this day, as well as those that vanished without a trace, were based on the same ideas which are usually attributed to Logo. Among these were general concepts, such as the individualization of teaching and an integrated approach to education because of its closer relation to real life, as well as the idea of the involvement in education of “outside” professionals.

The teachers who were ready for change were mostly from informatics since this subject was new and had not yet assimilated the traditions of the old school nor had yet to develop new traditions of its own. This was probably related to the very essence of informatics, which stood apart from all the other school subjects. Vyacheslav Aspidov, a young educator from Perm, talked about this: “I am certain, that we, informatics teachers, somewhat differ from all other school instructors. We have at our disposal a room full of modern, often state-of-the-art technology. Whether we want it or not, this by itself changes the traditional ways of our work.”

Those teachers who were thinking about change were looking for the possibility of project-based education and an individual approach to every student. They were ready to accept the ideas of Logo as natural, consistent with the processes they observed.

In other words, Logo as an educational philosophy met a receptive audience in Russia. The ideas were in the air; “the soil ready for sowing.” Thus the meeting between Aleksei Semenov, the general-director of INT, and Seymour Papert in 1987 in Bulgaria at the conference “Children of the Information Age”, which marked the starting point of the history of Logo in Russia, took place at the right time.

INT, which became the center of dissemination of Logo, had a diverse profile. INT actively supported various educational projects, believing that they were the key to diversity in education. On the other hand, INT always emphasized a specific educational philosophy, the fundamental principles of which were similar to those of Logo. These principles are formulated in the core documents of INT as follows: “The development of the students’ abilities to seek and uncover the truth on their own, acquiring and applying skills for solving novel problems is of utmost importance to the educational philosophy of INT. This approach brings the activities of the teachers and students

closer to those of scientists, engineers, artists, and professionals in general. It is akin to the modern constructivism which grew out of the Piaget school. On a more general level, this is in accordance with the general development of the modern school, characterized by a problem-oriented, project and research-based approach.”

Thus, INT’s efforts in promoting and supporting Logo in Russia was in essence a continuation, and a practical application of its educational philosophy. Logo was the realistic model which successfully illustrated the idea of the project based approach and the benefits of using computers.

From this point of view it was fortunate that the first Logo program in Russia was LogoWriter. This program was definitely a good instrument for the realization of the project based approach (apart from turtle graphics and a programming language) through the turtle shapes and the possibility of working with text and sound. Its old-fashioned reliability and flexibility also deserve to be mentioned. Note that LogoWriter is still being used in many Russian schools and prompts exceptionally positive comments from teachers.

There is a principle: the quality of the instrument defines the style of work and the quality of the resulting product. The history of using LogoWriter confirms this observation. Often teachers of the old tradition, who at first used Logo exclusively as a language for teaching children computer programming, gradually, starting with the “democratization” of programming exercises, “condescended” to using computers and Logo for such practical purposes as preparation of physics and biology projects.

We should mention that versions of Logo for different computer platforms from various unknown sources appeared before LogoWriter officially came out in Russia. The fact is that Logo does not spread easily “on its own.” Certainly, informatics teachers willingly exchanged software and therefore would see Logo at one point.

However, this did not result in any substantial application of Logo in the classroom. Logo was only used for a short time: teachers would try Logo without finding “anything special” in it.

The reason for this appears to be simple. The views about what to do with software in the classroom were still rather narrow at the time. There was not much need for using Logo in the traditional way, as yet another environment for teaching computer programming. Basic, Pascal, C, and Modula were satisfactory; the “ecological niche” had been filled. When used as a programming environment, Logo was introduced by the teacher as one more computer language, albeit a somewhat exotic one. The idea of using Logo as a new approach to education, such as programming for solving problems in other subjects (supporting other subjects), did not occur to teachers upon becoming familiar with the software. They were able to appreciate and understand these ideas, however, once they were expressed explicitly.

The practical application of Logo in Russia clearly demonstrated that Logo is a complex instrument composed of many organically interconnected parts, such as the software itself, a set of educational concepts, exchange of ideas and others. If you separate the material part, i.e. the software, from the rest, then it becomes clear that the non-material parts, i.e., the educational concepts, seemingly very “light” at first glance, outweigh the material part by a great margin. The software on its own did not have much meaning in the eyes of the teachers. The value of the software increased enormously when it was accompanied by the explanation about how education could be organized differently, examples of teachers working with Logo, and, finally, teaching guides and examples of projects. The “talk” about Logo and the relationship between educators convinced by it, the existence of the Logo community of teachers, all played the role of that detonator which is responsible for the explosion that took Logo into

classrooms, as well as into the minds of teachers and students.

After being introduced to the ideas of Logo, there were cases of teachers who would radically change their teaching techniques, without necessarily using actual Logo programs (for example, because the school did not have computers).

Thus, it was obvious that distribution methods, applicable to usual software, would not work in the case of Logo. Since INT considered its major goal to be the distribution center of new educational technologies, it put a lot of emphasis on all activities related to Logo, not limiting itself to the sale of the software. The ideas of the Logo approach to education were an organic part of the set of views promoted by INT. Similarly, the practical affairs of INT related to the distribution of Logo became a natural part of the institute's everyday work.

All this began with a limited, experimental distribution of LogoWriter by oral permission from LCSi and with Papert's blessing. At this time, a few advanced schools and non-academic institutions were working with Logo. These were mostly in Moscow except for school #470 in St. Petersburg where Sofia Gorlitskaya taught.

What exactly were INT's Logo activities? First, INT's members themselves taught Logo classes in schools and computer clubs. The general-director of INT, Aleksei Semenov and both authors worked in School #57 in Moscow. (Sergei Soprunov still teaches there.) Since some of these schools were already experimental, Logo as a new technology fit in quite well. These schools had obtained official status that allowed them to choose their curriculum and teaching methods. Usually, the groups of students that had Logo classes were not taught according to a traditional curriculum in their other classes either. They were using programs developed by teachers as well as methodology offered by INT. The same could be said about computer clubs. The two major computer clubs in

Moscow, "Computer" and "Zodiac", were, in essence, experimental grounds for the approval of various new educational technologies and many INT employees worked in these clubs on different projects.

Secondly, INT organized forums to promote INT's philosophy: various types of meetings with teachers, presentations, exhibitions, demonstrations of the software and the curriculum. Somewhat later, in December of 1994, a teachers' club named "TechoLogia" was organized. Again, the main emphasis here was on discussions of alternative approaches to education including Logo and a wide selection of other programs. It was interesting that as teachers became interested in Logo, they were more open to other new educational programs. Different types of activities, in this case, complemented and enriched each other, so that a wide range of interests did not get in the way of a deeper understanding of Logo.

Thirdly, INT gave and continues to give many instructional workshops and consultations about Logo and numerous other subjects for teachers. The first Logo seminar was held by Seymour Papert and Brian Silverman in 1988. The audience included teachers and members of INT. The future members of the Russian Logo groups were introduced for the first time to various aspects of the Logo phenomenon, and, along the way, received a wonderful lesson on how to work with teachers. This seminar and the next one, held with the assistance of Michael Temple two years later, had a decisive effect on the development of Logo in Russia.

Most of the workshops that INT organized integrated Logo with other subjects, for example, "Language and Mathematics in elementary school" and "Integrated approach to teaching subjects in the natural sciences." These workshops were very popular among teachers. From time to time, foreign educators took part: it is a pleasure to recall the spectacular presentations of Marilyn Shaffer from Hartford University and Monica Bradsher of

the NGS. Naturally, such seminars could only provide an introduction to Logo. A large number of in-depth Logo workshops were held as well in Moscow and in other cities.

Apart from these activities, INT also took part in the localization of Logo. It seems to us that translation of software is in many ways similar to more traditional translations, such as translation of books, and touches on many of the same aspects, from purely technical points to linguistic and pedagogical ones.

Thus, in particular, although the developers of LogoWriter envisaged it as an educational environment, in the Russian schools the program ended up almost exclusively in the hands of informatics teachers, who tended to view it solely as a programming language. Of course, these teachers, mostly with a computer programming background, had a very definite picture of what a program of this style should look like. The idea that the child should interact with the computer in his native language, the very essence and goal of Logo, went against these views. The programming languages to which the teachers were accustomed were using English vocabulary, had formal documentation, etc. As a result, it was not feasible to simply translate the primitives and messages of the program into Russian. This would have prompted an instinctive protest from the teachers.

In order to make the transition to the Russian version smoother, we decided to make the program bilingual. This meant, that the users had at their disposal both the English primitives and their Russian equivalents. In the same program, both English and Russian words could be used. Some teachers made use of this feature in their methodology: the children had to write the body of the program in English, but give the procedures Russian names. They believed that this made structured programming more transparent and emphasized the difference between primitives and user defined procedures. This

might sound nonsensical: imagine a classroom of American children sitting behind a computer and moving around a turtle on the screen with enthusiasm, putting together at the same time Russian words out of unfamiliar Cyrillic letters.

Logo in Russia is bilingual to this day, but now this is a relic of the past. Although some teachers still use English names for primitives, many, who were unhappy with the usage of the Russian “esli”, because they found the English “if” more scientific sounding, gradually made the transition to Russian in programming.

Another subtle point was attempting to keep the original style in the vocabulary of the translation. Wherever it was possible, the command verbs were given in imperative form to emphasize that the “child is controlling the turtle”. On the other hand, the error messages were made to sound as soft and friendly as possible, using formulations which did not make the children responsible for the mistake. It is well-known that children interpret any unexpected message from the computer as a bad grade, as a reproach rather than useful information. The younger ones often erase the messages without reading them, as soon as they appear. Unfortunately, this principle was not followed in all Russian versions of Logo. In some cases, a mistyped command name prompted the unfriendly and useless response “Incorrect name!”, without even pointing out the particular command.

The documentation also required adaptation to local customs. Russian informatics teachers were used to a more formal exposition and more detailed description of the structure of the programming language, than the reference guide provided. The style of the Russian version is characterized by chapter names such as “The structure of the system”, “Basic data types”, etc. This was not a change in the structure of the document, rather an adaptation of its style. Later, with the kind permission of LCSi, a few Russian textbooks were added to the original documentation.

The effort in resolving general localization problems of LogoWriter resulted in well-made decisions allowing the Logo group at INT to translate the subsequent Logo programs in the same style and traditions. This was clearly convenient for the users. The acquired experience also made it possible for INT to participate in various international projects: INT translated LogoWriter into the Czech, Lithuanian and Korean languages with the permission of LCSi.

The Russian translation of *Mindstorms*, which came out in 1989, had a huge impact on the implementation of Logo in Russia. Some teachers contacted INT and asked to be included in the experimental project after having read the book, because they were so excited by its ideas. It worked in the opposite direction as well. Teachers familiar with Logo, who were reaching a dead end on the road of “teaching programming for its own sake,” were directed towards project-based work.

The period of experimental distribution of LogoWriter showed that this program was interesting and useful for Russian schools. A large number of schools “joined” the experiment using illegal copies of the program, partly because of deeply rooted customs and partly because it was impossible for them to obtain the program officially with documentation and accompanying materials, consultations, and participation in the seminars.

This rather long experimental period ended in 1992 with the signing of a contract between INT and LCSi. The contract stated “that the Institute of New Technologies in Education of Moscow has been appointed exclusive distributor of Russian LogoWriter.”

In the same year, the Moscow Department of Education decided to help schools with acquiring software for their educational needs. Up to that point, this problem had to be solved by the schools themselves. The department decided to buy a city-wide license for the set of most popular programs. Which programs on the market were

deemed to be popular was judged in a manner rather unusual for the Soviet Union. A long series of presentations was organized in the building of the Moscow Department of Education, where INT and other developers showed the products they were distributing to visiting teachers. The teachers were then asked to complete a survey evaluating the programs’ usefulness and feasibility for their schools.

LogoWriter was among the top choices in this survey. Thus, using this license, any Moscow school equipped with MS-DOS computers could become a registered user of LogoWriter if it wished to do so. At the end of the validity of the license, about two hundred schools had taken advantage of this opportunity.

The license included not only the software with all of the Russian language documentation and materials available at the time, but also instruction seminars for the teachers. In effect, this led to a new informal Logo-society of teachers, first concentrated in Moscow, but later extended to other regions of the country.

In the next few years, Logo became well-known in Russia. Most teachers were aware of Logo, even those who had not worked with it. INT’s method of distribution was still the most productive, leading to subsequent regular usage in schools. Naturally, the traditional software distribution of “you use it, give your friend a copy” also worked, but with much less efficiency. In this case, there would be no documentation or built-in support accompanying the software, resulting in an unhappy experiment of a teacher loading the program and being disappointed that he or she could not do anything with it.

We often witnessed “moments of enlightenment”, when an experienced informatics teacher would recall the first encounter with Logo: “Wait a minute! I cannot believe it: this is Logo? I did try it once ... and somehow could not see that it was so interesting. If I knew this THEN... This was exactly what I needed.”

LOGOWORLDS

In summary, the first stage of the introduction of Logo into Russia gradually transformed Logo from something exotic into a working instrument. After changing its “immigrant status” to “citizenship”, Logo received all the benefits and the liabilities of the new status.

The appearance of new, more modern versions of Logo in the West generated a lot of interest among Russian teachers. They now lived in a more open society and had access to various sources of information. INT, which claimed the role of coordinator of the Russian Logo community, encouraged this process, promoting independence and contacts with the West, aiding the application of information technology and establishing connections with the world’s Logo society.

Under these conditions, a probation period of five years, as was in case of LogoWriter, would have been unacceptable for the new versions.

Fortunately, the conditions have improved since the beginning of the LogoWriter era. LCSi, despite all notions about “sharks of capitalism,” showed a lot of trust and compassion towards the Logo group of INT. This enabled us to begin the development of the Russian version of the software right after the completion of the English one, sometimes even in the process of its creation.

On the technological side, the equipment in the best Russian schools was not much behind that of the West by that time. INT established close relations with the Apple, and promoted Macintosh computers in Russian schools. IBM-compatible computers also appeared in Russian schools. Russian schools were often in a better situation than the Western ones. New computers could be installed at once, since the Russian schools either had no computers to begin with or computers that were obviously obsolete.

Thus it was not surprising that the next generation of Logo software, MicroWorlds, appeared in Russia within a reasonable, relatively short delay. The Macintosh version was introduced in 1994, and the MS-DOS version in 1995. The Russian version was named “Logomiry”, which means “Logoworlds.”

At the same time, the attitude towards computers in schools gradually changed. At first, a computer was thought to be a complex device that could only be understood by a small group of experts: “It would certainly break if an outsider approached it.” Or computers were viewed as forbidden fruit since the students would play dreadful games on them whenever the teachers were not looking. Now the school principal used the computer to type up orders, mathematics teachers made up tests, students printed out homework assignments. In advanced schools, e-mail was actively used for correspondence. Teachers slowly became convinced that working with computers does not require extraordinary abilities or intelligence.

In earlier times, the teachers in computer classes either were knowledgeable about using and programming computers, but did not know how and what to teach to children, or had an education degree but were uncomfortable with using and operating computers. Usually, the one-sidedness in both cases resulted in a nervous indecisive atmosphere in the classroom. There was a tendency to conduct classes in a fashion similar to “Now press this button. See what happens?” Obviously, this gave little opportunity for children to express their creativity.

Now, teachers appeared who were confident in dealing with the computer, thus less “technology-oriented,” and put much effort and thought into how and what to teach. This, naturally, affected the attitude towards Logo. Logo was no longer a secret available to a few, but it still kept its status of an emotional “personal discovery” for many fans. Learning Logo was not part of the mandatory

preparatory course work for teachers; teachers were never forced to take Logo classes. The teachers themselves took an increasingly active role in the dissemination of Logo (the ideas and not the software). This was demonstrated by a scene at a presentation of INT's products. A few teachers gathered in a circle and one of them announced: "They are going to try to dump all this software on you. Believe me, it's all worthless. The only software that is really useful is LogoWriter. Try to get it. I can teach you how to work with it." (The speaker obviously did not know that INT is connected to LogoWriter.)

At this stage, one of the most serious problems of the promotion of Logo in Russia became very visible. This was the acute shortage of literature for teachers. We will not tease our reader: this problem still has not been solved. There was little reading that explained the ideas of Logo, described successful examples of the project-based or the child-centered approach of teaching in a regular classroom. And there were not enough curriculum guides and sample exams, traditional to Russian schools either. These guides and materials were the "crutches" for many teachers, which helped them feel confident before they started working on their own.

To a small extent, the teachers themselves helped to compensate for this deficiency. As we have noted above, Logo was a very personal thing for many teachers. No one thought of Logo as something imposed upon them or something alien. Because of this attitude towards Logo, many teachers gladly (and in most cases without compensation) shared their discoveries in the field: they showed their students' work, wrote their own teacher guides, created collections of project assignments. We note that this personal relationship with LogoWriter led to the fact that teachers would very unwillingly make the transition from LogoWriter to the more modern MicroWorlds. Certainly, this is not the only nor the most important problem of the coexistence of LogoWriter and

MicroWorlds. However, further discussion of this topic is beyond the scope of this paper.

The number of Logo publications in various journals by teachers was high since teachers involved with Logo were much more active and eager to share their experience and knowledge than the average. In a special 1995 issue of the magazine "Informatics and education" in Moscow, 12 out of 23 articles were one way or another related to Logo.

Not surprisingly, all these independently developed teaching materials showed a great stylistic variety. Logo could not be considered a good educational instrument if it forced all the teachers into the same "procrustean bed." It was equally not surprising, but less agreeable, that these new texts and guides often followed the traditional Soviet ideas about the role of the computer in school. We are hoping that such attempts at combining incompatible things will not be scorned and ridiculed by our readers, at least by the ones who remember the first class they conducted on their own, but rather will be met with compassion and understanding.

The major role of Logo in schools can be described as follows:

- Students learn Logo for learning's sake (here we are talking about the software only), just as people sometimes learn the Norton Commander: they do not learn about the general structure of the file system and its operations, they simply learn how to work with the program, that is what keys to press to do this or that.
- Students study the basics of algorithms and programming. Logo is used as either the major environment for programming or as an example of a programming language. In elementary schools the goal might be phrased more modestly as "cognitive development"
- Logo is used to convince students that a computer is a convenient instrument for everyday work. Students create projects on elected themes and for other school subjects.

Project work is considered more troublesome than teaching classes in the style “Write down today’s topic and now we check the homework”. (One informatics teacher said “During these classes I feel that they could move along all by themselves and all I have to do is tap the rhythm on the desk”). However, everybody agrees that this goal can only be achieved by giving the students long-term, rather independent assignments and that the project-based approach solves motivation problem in schools.

Unfortunately, the cooperation between the “subject” teachers and the informatics teacher is still rare even though it would be useful in Logo projects related to history and biology. More often the project is a personal initiative of the informatics teacher, and since there is no mandatory curriculum, the teacher selects a project based on his or her own interests and education. We recall two examples of such projects which are aimed at the study of a native city. One of them is “Buildings of St. Petersburg” made possible by Sofia Gorlitskaya and the other “Moscow studies” by Larissa Stratiy from Moscow.

The idea of collaborative or support work is rather natural to a Russian computer teacher. Because of their status, computer teachers are always doing subsidiary work. The principal calls for help because he cannot print out an urgent directive, the English teacher asks for a crash course on how to prepare handouts. The idea of cooperation is usually initiated by the informatics teacher. The movement of “subject” teachers towards cooperative projects is much slower, although by now they are intrigued by computers. They are caught in a vicious circle of not being convinced of the computer’s usefulness in their field until they see actual examples of such work, but there will be few such projects until the teachers show interest in the computer use.

One possible stimulus for cooperative work could be the fact that “dual” classes were recently introduced in many regions of Russia (in Moscow, in particular). In reality,

this means that both teachers get paid for these classes so the two teachers are equal partners. This decision by the educational officials is important since it is an “official” recognition that integrated learning is progressive.

The style of teacher workshops is also changing. Most informatics teachers have seen how the turtle moves across the screen after the “forward” command. Many teachers have their own ideas about the application of Logo, and what exactly the project-based approach is. Teachers want to know more about the deeper and more complex aspects of programming in Logo. They ask about new multimedia and internet possibilities. They need fresh ideas for projects. Demand for workshops such as “Logo for mathematicians” and “Logo for primary schools” has developed.

The introduction of Logo into other subjects has led to its “stretching” over the age groups. Initially, the software was used in grades 6 to 8 and was mostly valued for its animation and turtle graphics. Everyday work gave the teachers a deeper understanding of Logo and confidence in using the program. This changed the initial notion of Logo as a “kid’s language.” Logo is increasingly used at the high school level and more and more teachers consider Logo a suitable instrument for their own work. Informatics teachers, sometimes with the help of students, create Logo-projects that serve as small-scale learning programs. For example, such a program could be aimed at studying the structure of the computer or the buoyancy law.

Another effect is that Logo is becoming less and less “serious.” When computer classes were initiated in elementary schools, the teachers noticed that even little children can create complex and interesting programs despite the fact that they have not yet learned what “structured programming” is. It has become widely accepted that Logo is the program of choice for introducing primary school students to computers. (However, the question whether

primary school students should be introduced to computers at all is still a topic of heated debates.)

The experience of working with Logo in elementary schools has convinced us that — Logo is an adequate instrument for little children and — that purely technical difficulties (such as writing down commands in text form and displaying error messages) causes unjustifiable discomfort to these children. With the kind consent (more precisely, kind “connivance”) of LCSi, INT began work on a special version of MicroWorlds, designed for preschools and primary schools, for “preliterate programmers.” The new program, named “PervoLogo” in Russian and “IconLogo” in English, became a collaborative product of LCSi and INT.

A characteristic distinction of IconLogo is that it is not necessary for the user to be able to read, write or know numbers to use it. In a sense IconLogo allows you to separate the teaching of the art of operating computers, including algorithmic thinking, from the teaching of reading and writing.

All turtle commands in this program are represented by images and pictograms. The child composes programs using these pictograms. IconLogo inherited the wealth of instruments and parallel processes of MicroWorlds, but it uses a simplified structure, so that, for example, the child can not make an error by not defining a parameter where it is needed.

In a linguistic sense, the picture interface of this software accomplishes an intermediate step in child development. It is well-known that children use body language to explain concepts for which they are lacking words. This body language is then transformed from its actual physical form into a pictographic one through IconLogo. Later it evolves into a linguistic form, and that is why many primary school and preschool teachers consider IconLogo an active means of speech development.

This program received a very positive response from the teachers of Moscow and various Russian regions, which was manifest in the swift spreading of the software. The program was also named “the best educational multimedia program for preschool and primary school students” on the 7th international exhibition ‘Information technology and informatics’ in Moscow in 1997. An acknowledgment of the world-wide recognition of INT in the field of informatics in elementary schools was when in 1997 INT, in cooperation with the Institute of Information Technologies in Education (IITE), prepared a report with recommendations for “Informatics for Primary Education” which was ordered by UNESCO. Logo played a major role in these recommendations, and the sample primary school informatics curriculum was based on IconLogo.

WHAT NEXT?

The recent rapid stratification of Russian society has had an effect not only on individuals but also on organizations such as schools and other educational institutions. A private school in Moscow, where the entrance fee is \$20,000 and the tuition is \$6,000 a year, does not surprise anyone nowadays. Just as no one is surprised by the letter received from an old colleague in Yaroslavl that says “Our school will happily participate in the Internet Logo project if only our phone service is not turned off for not paying the bills...” Logo seems to be a program for all classes of society. It is used in private and public schools and in non-academic organizations such as clubs and camps. Comparing Logo in schools and non-academic institutions shows that the best projects are very similar regardless of where they come from. In a Logo class taught by a good teacher, the students do not feel constrained or coerced, but essentially like participating in an extracurricular activity.

The separation of schools by social classes leads to a similar separation in the quality of computer equipment. A private school in Moscow buys a Pentium II for every student. In a regional school outside of Moscow, however, a classroom of 386s is considered an unrealistic dream. This explains the fact that the demand for LogoWriter is still quite strong, despite the availability of MicroWorlds for MS-DOS and Windows 95.

Pirate (bootleg) distribution of software, including educational software, is very popular in Russia. The causes for this are psychological rather than financial. Currently, the statement “It’s not that I’m stingy but I never buy educational software” is said openly and is met with understanding. One experienced teacher, who bought LogoWriter legally, put several interesting projects of his students on the Internet. On his web page, he offered his copy of LogoWriter for a free download. Like most social attitudes, this situation is changing slowly.

Traditional educational software, including Logo, has been viewed in Russia as strictly for schools and other educational establishments. The formula “child + home computer = DOOM” has never been doubted. Also, not many people had computers at home. Recently, parents are showing signs of increasing interest towards educational software. Teachers working with Logo often ask: “Can we make a copy of our program, so that the students could work at home?”

A major difficulty in using Logo in schools is the bureaucracy of the school system. One example: teachers are often required to furnish a day-to-day plan with topics and goals worked out for every class for a year in advance. Needless to say that a teacher who is planning to teach Logo in a project-based manner will have difficulty in producing such a plan and even greater difficulty following it. And a teacher must be a clairvoyant to predict, say, the appearance of a cooperative mathematics teacher in the school!

Logo has even more serious problems in high schools. Parents who showed great interest in “computer education and cognitive thinking” and inspected multimedia projects with pleasure while their children were in grades 6 to 8, lose all interest in modern educational ideas during the high school years. They are all focused on standards of education and admission examinations to colleges. Thus, until there are entrance examinations in informatics with traditional and conservative standards, the high school informatics teacher will feel not only a personal responsibility that their students know what the “bubble method of sorting” is, but will also feel a natural external pressure from the parents.

As a result of these limitations many informatics teachers are forced to attempt the impossible. They try to include everything in their course, from information about the “metal parts” of computers to special skills in working with user programs. Usually, Logo is on this list as a tribute to the fashion of educational programs, somewhere between games and Microsoft Office.

One of the most serious problems in promoting Logo (and this problem will get more acute as we try to introduce Logo into homes) is the shortage of relevant literature. There are few guides for teachers and very little reading for students, not enough textbooks and Logo-related reading in general. Recently, the government of Moscow recommended “the educational environment IconLogo” as a course for primary schools, and “the educational environment LogoWriter” for middle and high schools. The more modern MicroWorlds was recommended only as an option. This shows a conservatism and lack of foresight on the part of the officials who do not understand that MicroWorlds is far more suitable to the needs of the schools, especially in Moscow. However, we think that the decision was influenced by the fact that there was much more literature available for LogoWriter than for the much more recent MicroWorlds.

Asking INT to solve all Logo-related problems would be destined to failure. However, INT never tried to take over all Logo-related activities. INT's mission was to organize a Logo community in Russia, thereby unifying Logo teachers and creating an independent and self-sufficient community. We cannot say that this called for much effort. Independence and self-sufficiency was the rule among the first generation of Logo teachers. Even though its organizational role is still very important, INT is currently more often engaged in coordinating Logo activities. It disseminates successful readings, initiates direct contacts among teachers, and aids the establishment of international relations.

As the Russian Logo society is shaping up, the roles of Moscow and St. Petersburg as Logo centers are declining. INT conducted long instructional Logo-courses in many regions of Russia: Sochi, Petrozovodsk, Yekaterinburg, Yakutsk and others. (If the reader does not have a world atlas handy, Yakutsk is, for example, located close to "Earth's cold pole" where everything is eternally frozen, while Sochi is a popular resort on the Black Sea.)

It is also very important that local teachers take the initiative for conducting different Logo-related events. Requests such as — "We have Logo, but we would like to understand how to use it. Could you please send us an educator for conducting classes for teachers?" — "A large group of teachers in our town has been working with LogoWriter for a while. Now we feel that we need more in-depth knowledge. Please, send us a specialist of the methodical aspects of working with Logo." — are more and more frequently heard on intercity telephone calls and seen in e-mails. Teachers tell us about regional competitions of Logo-projects, Logo summer schools, openings of Logo-sites. We are certain that we do not know about all such regional Logo activities.

Possibly this is not the right time to describe and analyze the history of Logo in Russia. The appearance of Logo in

our country coincided with many serious changes in people's everyday life and these changes are still in progress. Russian education has also undergone changes, in many aspects, cardinal ones. Maybe the appearance of Logo somehow aided these changes, but it is hard to separate and assess the extent of this effect, since there were much more serious factors involved. What we can say with certainty is that Logo's general philosophy is in accordance with the progressive changes that occurred and that are still in progress in Russian schools.

These changes are happening so fast (one is compelled to say "too fast") that we cannot tell which will remain and which will dissolve and be forgotten in a few years.

At the moment, teachers consider the project-based educational approach to be very productive, despite the accompanying difficulties. More and more schools are using a variety of open-ended software including Logo, for creating projects.

As time passes, it will become clear if the Russian Logo society is viable, and if teachers have enough interest and enthusiasm for Logo's successful implementation, or if after awhile Logo simply becomes a "curtsy" to "cognitive thinking" and the "project-based approach."



A Logo Postcard from Argentina

by *Horacio C. Reggini*

Horacio C. Reggini is a consulting engineer and professor in education, computers, and telecommunications. He has recently published two books relating to telecommunications: *Los caminos de la palabra. Las telecomunicaciones de Morse a Internet (1996)* and *Sarmiento y las telecomunicaciones. La obsesion del hilo (1997)*. He is a full member of both the Argentine National Academy of Exact, Physical and Natural Sciences and the Argentine Academy of Information Arts and Sciences.

No author can escape his singular first memories of a subject. To recount my own involvement with Logo in Argentina, I must remark upon my perceptions of its development, techniques and beauty. I must also go back to the early stages of computers.

THE START OF MY LOVE AFFAIR WITH COMPUTERS

My initiation into the revolutionary world of computers took place nearly four decades ago. In 1959, while on a scholarship at Columbia University, I came across the discovery of the century at the IBM Watson Scientific Computing Laboratory in New York. At that time, computers were not only extremely expensive but also virtually impenetrable. Computer programming was an interminably tedious task. Yet it was through this initial contact that I became aware of John von Neumann's fascinating book *The Computer and the Brain* (1958), which shed new light on the computer's potential:

"... Since the orders that exercise the entire control are in memory, a higher degree of flexibility is achieved than in any previous mode of control. Indeed the machine, under the control of its orders, can extract numbers (or orders) from the memory, process them (as numbers!), and return them to the memory (to the same or to other location); i.e., it can change the contents of the memory -indeed this is its normal modus operandi-. Hence it can, in particular, change the orders (since these are in the memory!) -the very orders that control its action-. Thus all sort of sophisticated order-systems become possible, which keep successively modifying themselves and hence also the computational processes that are likewise under their control."

Captivated by these concepts, I decided to delve into the bold new computer era. Back in Argentina in 1960, I began to work as a university professor on different projects in the computer field. One such project was the establishment of the first Computer Center for Undergraduates (based on the IBM-1620) at the School of Engineering at Buenos Aires University.

In 1963, as a member of the MIT Interamerican Civil Engineering Program, I encountered many pioneers of the digital world, including Marvin Minsky, J. C. R. Licklider and Robert Fano. I was also lucky enough to bear witness to one of the most wondrous phases of computer evolution: the MAC Project at MIT. (The acronym MAC stood for both "Machine Aided Cognition," the general goal of the project, and "Multiple Access Computer," its operative mode.)

My belief in the power of computers prompted me to become involved with the MAC Project itself. By 1964, I was able to log into the MIT IBM-7094 time-sharing system from Buenos Aires, Argentina — thousands of miles away — via a radio teletype link. This experience had a profound impact on me and was the impetus for my research on how technology contributes to people's intellectual and creative development.

In the '70s, the invention of small personal computers enabled these machines to escape the narrow confines of laboratories and large organizations. It was then that I met Seymour Papert whose philosophy and research on Logo strengthened my commitment to help unleash the power of computer technology. Focusing on education, I was especially concerned with how information technology could help children find new and better ways of learning. Logo, with its wealth of possibilities, pointed the way. For me, Logo was a form of poetry which has the same relation to the prose of computing as poetry has to prose in any other language.

LOGO LAUNCHED IN ARGENTINA

Among Papert's Logo projects that I visited were the Brookline Public Schools in Boston and the Computers in City Public Schools in New York. In 1980, I also observed the Logo pilot project at the Lamplighter School in Dallas, Texas, where I was delighted to see students and teachers excitedly running Logo procedures on Texas Instruments TI-99 Home Computers. Although the TI Logo software had many drawbacks — drawings could not hold many lines because the turtle would “run out of ink” and decimal numbers were not accepted — it paved the way for those hoping to run Logo in a personal computer.

I soon came to an agreement with the Texas Instrument Argentine branch to develop a Spanish Logo version for their TI-99 Home Computer. With the Spanish Logo available in Argentina and neighboring countries, including Uruguay, I considered it essential that Logo's ideas be printed in Spanish. So I founded Ediciones Galápagos, a small publishing company that translated and published numerous titles: *Mindstorms* (under the title *Desafío a la mente. Computadoras y educación*) by Seymour Papert in 1981; *The Second Self (El Segundo Yo)* by Sherry Turkle in 1984; *The Society of Mind (La sociedad de la mente. La inteligencia humana a la luz de la inteligencia artificial)* by Marvin Minsky in 1986; and *The Media Lab (El laboratorio de medios. Inventando el futuro en MIT)* by Stewart Brand in 1988.

WINGS FOR THE MIND

In 1982, I wrote my first book on Logo, which was widely used in Spanish speaking countries: *Alas para la mente. Logo: un lenguaje de computadoras y un estilo de pensar (Wings for the Mind. Logo: a Computer Language and a Style of Thinking)*. An English translation of the prologue follows:

“This book is addressed to those who wish to explore the new concept of computers as

extensions of the mind. In choosing the title of the book Alas para la mente (Wings for the Mind), I deliberately avoided the words “computer” or “computation.” Although these terms are becoming part of our daily vocabulary, for many people they are still obscure words that conjure up the mysterious and the unattainable. In the past, specialists employed such esoteric language to restrict their spheres of knowledge to those in the same fields. Alas para la mente, on the other hand, attempts to demystify the world of computers, making it accessible to everyone.

Critical thinking and the exchange of ideas are key factors in the process of learning. Young people often rise to meet new challenges, but sometimes their ideas are not powerful enough to take wing. So it was with Icarus who, in escaping from imprisonment, fell into the sea when the wax of his wings melted as he flew near the sun. Alas para la mente attempts to provide students with effective “wings” for thinking. These “wings” are intended to take readers on journeys of their own choosing: far away in the analysis of external phenomena or deep within themselves in contemplation of their own styles of thinking.

Alas para la mente is a step-by-step introduction to the fundamentals of Logo as well as an account of experiences I have had watching children learn with Logo. One of the book's major premises is that to use computers creatively we must follow two paths — that of our innermost intuitive thoughts as well as that of logical analysis. Many of the book's other chief principles stem from Seymour Papert's beliefs outlined below:

- *The computer is an outstanding learning tool.*
- *The computer can be a natural and enjoyable context for learning mathematics.*
- *Computers foster children's intellectual and emotional growth by helping them to better understand how they think and feel.*
- *Almost instinctively, with little or no external help, children develop inductive and deductive reasoning.*
- *As children get involved in what they do, knowledge becomes meaningful and learning evolves naturally.*
- *Numbers become meaningful to children once they are needed to achieve specific goals.*
- *A natural bond is quickly established between computer and user when the interaction is more along the lines of a friendly dialogue rather than a formal lesson and when the computer is personally meaningful to the user.*
- *Children begin to grasp reality when it becomes a representable object that can be divided and combined into manageable and comprehensible units.*
- *Both body syntonic and ego syntonic learning take place.*
- *Children are given the opportunity to see what they think as their thoughts spring to life on the computer screen.*
- *The aesthetic dimension is continually in the forefront.*

While this book is intended for children, adolescents and adults, one of its main objectives

is to help specialists in different fields look at computers from a different standpoint."

Alas para la mente was translated into French — *Logo, Des ailes pour l'esprit*, Cedic/Fernand Nathan — in 1983, and into Italian — *Logo, Ali per la mente: il linguaggio di programmazione ideato per l'educazione e il gioco creativo*, Arnoldo Mondadori Editore S.p.a., Milano — in 1984.

THE LOGO SPIRIT CATCHES ON

With personal computers gaining popularity in Argentina in the early '80s, I began to organize numerous workshops, courses and seminars for teachers across the country. Three enthusiastic assistants helped me during this period: Teresa Carabelli, Mercedes Torino and Paula Bontá, presently Director of Design at LCSi in Quebec. To help spread the news of Logo, I wrote many articles for national and local newspapers and did interviews for magazines and TV programs. Teachers and other educational experts were eager and enthusiastic to participate in the new digital world. Most of what has been done with Logo in Argentina grew out of the dedicated efforts of small groups, mostly school principals, teachers and parents from family school associations.

One school in particular, the Instituto Bayard (Bayard Institute), led the way. The principal and owner of the school, Annelise Henriksen de De Forteza, ensured that all teachers were trained in the Logo method, after which the students began to develop Logo projects. The Instituto Bayard became a Logo "lighthouse" for many educators in Argentina and South America in search of innovative changes in education.

FIRST INTERNATIONAL LOGO CONFERENCE

In 1982, the *Asociación Amigos de Logo (The Friends of Logo Association)* was founded by an ardent group of Logo

enthusiasts, including myself. A non-profit organization with little outside support, the association aimed to promote the growth of Logo ideas. Our first big step was the organization of an international conference held on September 16/18, 1983, at the Instituto Bayard in Buenos Aires: *Primer Congreso Internacional Logo. Las Computadoras en la Educación y la Cultura (First International Logo Conference. Computers in Education and Culture)*. It was sponsored by the I.B.I. Intergovernmental Bureau for Informatics (Rome), the UNESCO (Paris), Subsecretaría de Informática, Ministerio de Educación, Secretaría de Cultura, and Secretaría de Educación de la Ciudad de Buenos Aires. Included below is part of my opening speech, which captures the spirit of the conference and stresses the educational philosophy underlying Logo:

“Dear ladies, gentlemen and children,

On behalf of the Asociación Amigos de Logo, I welcome you to this conference. Many people, from neighboring and distant countries as well as from other cities of our country, have come to join us on this occasion.

Some time ago, when seeking a venue to hold the conference, we first thought of theaters, auditoriums and other places often used for these kinds of activities. But we wanted a different kind of place for this conference. We fancied a natural setting with trees, plants, and flowers. And, as it often happens, the nearest, most loved and familiar things are those that we disregard, those which we are not aware of. It is only when they are no longer with us that we start to miss them. One day, while coming out of the main office, we became aware of this patio. A place with plants, flowers and a magnificent tree. A

place full of life, joy and love. This patio became the right place for our conference.

Some of you here today want to know more about a new kind of computer language, Logo, which may have applications in many fields — professional as well as commercial and industrial. Other people believe that Logo is more than a mere technological innovation and that it can open new paths in education.

The purpose of Logo is to contribute to overall human development, a primary educational goal. Through Logo, computers can lay the groundwork for such learning, while respecting students’ linguistic and cultural identities.

From an early age, children draw from the environment around them to develop coherent theories about the world — i.e., naive theories — as an aid to understanding. Since the knowledge acquired is limited by environmental boundaries, however, children may lack the resources to turn certain concepts into concrete ideas.

The computer — a modern Aladdin’s lamp — provides children with those models they cannot find in the real world. Because the machine can transform formal thinking into concrete thinking, it can help children acquire this type of knowledge more quickly, thus stimulating their intellectual development.

In an ideal educational environment:

- 1. Children reflect on what they know and express it in a coherent way in order to be understood. In explaining and defending their ideas, children gain self-confidence and an awareness of the power of their own ideas.*

2. *Children participate in a well-developed, qualitative approach to knowledge.*
3. *Children are not afraid to make mistakes. What's important is not whether one makes an error, but whether the error can be rectified.*
4. *Children are encouraged to be creative and to interpret the world from their own viewpoints.*
5. *Children are on an equal plane with adults in relation to their intellectual product.*

Putting such educational principles into practice is difficult to achieve in ordinary classes. This is where computers — equipped with a suitable language — can help. A Logo procedure — teaching the machine how to do something — is the formalization of a piece of knowledge. This formalization can be tested, executed and verified. For the computer, a procedure is a sequence of intelligible and executable phrases. For the computer user, the procedure is the expression of the user's understanding of a concept. As that understanding can change, a procedure is also subject to change, improvement and ongoing revision.

In the Logo environment, it is vitally important for students to discuss their work with teachers and classmates. For the student, building a procedure is not only naming a series of instructions: it is an initiation into the abstract world and the subsequent concrete manipulation of ideas. With Logo, students learn to analyze problems, deal with abstractions and formalize solutions to problems. Students also learn to apply

constructive self-criticism and to regard errors not as disasters, but as temporary obstacles to be overcome.

Frequently, success in learning depends on both intellectual and emotional factors. Children's preference for a particular area of study depends on their ability to assimilate this special type of knowledge into their own set of models. These intellectual models, different for each person, are acquired in the course of a lifetime. Learning comes more easily when the subject matter is of personal interest than when it's unpleasant or incomprehensible. What children learn depends on the models available to them.

Because the computer adopts innumerable forms and offers a wide range of models to suit individual interests, it helps to overcome such barriers to learning. Also with the computer, the steps of learning are inverted: students come into contact with the practical uses of knowledge before being exposed to its formal enunciation.

A primary goal of education is to help children use their freedom in a responsible way. From an early age, children assume responsibility for their actions as they exercise their right to choose. With Logo, children freely organize their microworld while assuming responsibility for what happens within it — i.e., the formulation of their course of study according to their own needs and the steps they will follow to reach their goals.

Working with Logo, children may form a mental image and then design ways to create that image. Or they may begin with no definite goal but then, with each step, discover

something new. Such activity resembles both scientific research and artistic creation, in which the learning process becomes a personal adventure marked by the element of surprise. In Greek philosophy, the teacher is the guide who helps the student to discover essential truths. The teacher does not present the truths but rather encourages the learner to discover them. The same concept applies to Logo.”

None of us could have anticipated the resounding success of the First International Logo Conference. One thousand participants attended from Argentina, Uruguay, Brazil, Colombia, Peru, Mexico, U.S.A., France and Spain. (Many of these attendants were also present at the Logo conferences at MIT in '84, '85 and '86.) The exchange of experiences and ideas was marked by a refreshing honesty that did not profess to have all the answers in light of Logo's ongoing evolution. Also stimulating were the original and spontaneous remarks of the many children who displayed Logo projects. Julián Marcelo, with Rome's I.B.I. Intergovernmental Bureau for Informatics, summed it up nicely during the closing ceremony: “This meeting has been an extraordinary blend of a scholarly seminar and a friendly weekend party.”

Although our keynote speaker, Seymour Papert, could not attend, Robert Mohl from MIT filled in with a strong case for the growing international status of Logo. This address, along with the conference's other lectures and papers, were valuable contributions to the international community of Logo and helped to consolidate Logo's position, not only in Argentina, but in all of Latin America.

New Logo versions and new personal computer models, such as LCSi's Apple Logo and IBM Logo, became available in Argentina. Building on the success of its Spanish Logo version for TI-99, Texas Instrument Argentina asked the Harvard Associates of Boston and my own team

to develop a Spanish Logo software for its TI-PC model. In 1986, we also prepared the Spanish Logo vocabulary and documentation for a MSX computer, assembled by Telématica S.A. in Argentina. Based on the MSX-Logo developed by LCSi in Canada, this computer became quite popular in Argentina, where it has been used in many schools. More recently, LCSi commissioned us to adapt and translate its LogoWriter software into Spanish.

3D-LOGO: IDEAS AND FORMS

In 1984 and 1985, I developed a 3D-Logo version that attempted to bridge the gap between traditional methods used to represent three-dimensional objects and current computer techniques. 3D-Logo allows the user to build three-dimensional objects based on Logo's intrinsic geometrical approach: the shape of any object can be described by defining the necessary movements of a turtle to trace its edges.

3D-Logo is body syntonic. One has to describe the object through the movements of one's body in space. In other words, a drawing on the screen is the result of the description of a succession of movements. The image is generated by the trail the turtle leaves as it moves in space; the representation of the image on the plane surface of the screen — through a central conic perspective — is performed automatically by the system. The perspective drawing depends on the starting position and orientation of the turtle. The incorporation of a spatial dimension in the Logo microcosm represents an important qualitative jump in the conception of the turtle as “an-object-to-think-with.” The turtle movements are not limited to a plane surface.

By teaching the computer to produce three-dimensional objects, one can better perceive the elegance and complexity of shapes in space. In allowing people to play creatively with their chosen subjects, the computer becomes a medium for human expression, both intellectual and

artistic. It offers the user the chance to experience the emotion and joy of the creative act.

The construction of 3D-shapes soon captured the imagination of children and adolescents to the point that it was not unusual to see all kinds of 3D-objects on computer screens in the schools of Argentina. My 3D experiences also gave shape to my second book *Ideas y formas: Explorando el espacio con Logo (Ideas and Shapes. Learning to Build in 3-D Space with Logo)*. A French translation followed in 1986 — *Logo dans l'espace*, ACT-Informatique, Cedric/Nathan, Paris — as well as an Italian version in 1987 — *Idee et Forme. Explorando lo spazio con il Logo*, Edizione Sisco Sistemi Cognitivi, Roma.

The focus of the book is on the similarities between the methods of technological production, scientific research and artistic creation. A work of art and a scientific project both seek to create order out of chaos. Both are complex undertakings that require immense effort and resourcefulness, extensive planning and revision, and a vast body of knowledge. Michelangelo's in-depth study of anatomy is reflected in the perfectly molded lines of his Moses or his David. So too, researchers and artists devote much of their time to countless tests, explorations and studies.

I later used my 3D-procedures in Object Logo (Paradigm Software Inc.) for the Apple Macintosh to carry out research on the geometrical generation of polyhedra using intrinsic geometry. The results were published in my paper *Regular Polyhedra: Random Generation, Hamiltonian Paths and Single Chain Nets*. One major finding was the determination of the number and the structure of all possible different paths along all the faces of a regular polyhedron without passing more than once by the same face.

COMPUTERS: CREATIVITY OR AUTOMATISM?

In 1988, I wrote *Computadoras ¿creatividad o automatismo? Reflexiones sobre tecnología (Computers, Creativity or Automatism? Thoughts on Technology)*. It brought

together a collection of articles and conferences on Logo, stressing the premise that only a wise use of new information technologies leads to freedom and creativity. The book also included an analysis of the ideas of Karl Popper and Seymour Papert. In the prologue, I reflect on the issues discussed in the book:

“Today, millions of people have an easy alliance with computers, which permit them to work, create and study autonomously. However, human interaction with computers is in its infancy and must await further developments for a true evaluation. What role will computers play in the future? We must search together for the answer.

Those who are enchanted by the novelty of computers anticipate a golden era when technology will provide us with untold benefits. On the other hand, those who are resistant to change warn of the dangers of an impending “cybernetic slavery” that will strip us of our humanity. Only a thorough understanding of the significance of computers and their myriad applications will ensure that their enormous technological potential does not turn us into mere passive receivers of information.

The road divides and we must choose between creativity and automatism. It would be erroneous to imply that the two are mutually exclusive, as they are alternative and complementary states. “Creativity” refers to the production of new or artistic ideas, while “automatism” implies a sequence of mechanical actions. Both processes are essential. Automatism, which is a result of previously acquired action scripts, requires creativity to set it into play. Automatism is a beneficial

component of computers, as it sets free other parts of the mind. But it is insufficient without the sparks of creativity that allow us to change or modify our routines as previously unknown goals or new possibilities come to the fore.

It is the responsibility of scientists to bring about the harmonious blend of new technologies and society. The more we learn about technology, the more we can perceive the essence of our humanity. For years, I have applied this principle to my different areas of interest: computers in general, computers in education, artificial intelligence, the design and construction of forms in space, the psychology of learning, and the development of scientific knowledge. It is also the basic concept that unifies this book and its variety of subjects.

Emerging computer theories are of vital significance to the process of human evolution. More than ever before, a sensitive use of the new technology is essential to avoid cultural fragmentation. My own contribution has pointed me in two directions: to influence the educational process in an attempt to transform computers into tools for creativity and personal growth; and to diffuse through the mass media proper methods and means to apply computers in various areas of daily life.”

CONCLUSION

Logo's expansion in Argentina arose out of small independent groups of people who embraced Logo not just as a computer language but as a philosophy. Thanks to this initiative, students reared on Logo have gone on to

graduate from MIT and to land jobs in the computer industry. Such success, however, cannot be attributed to government support on a local or national level, since most official projects dealing with educational software have relied on computer companies for training and support.

The status of Logo in Argentina has been constant for some time. Many schools continually strive to better understand Logo and make effective use of it, while others scarcely glimpse Logo's potential. One of the schools that recognizes Logo's value today is the Colegio Las Cumbres in Buenos Aires. There, Mónica B. Coni, in charge of staff development, conducts ongoing teacher training and makes innovative use of Logo applications.

Although Logo was enthusiastically adopted in many Argentine educational institutions, this initial zeal has abated somewhat in recent years. A major obstacle has been the tendency to perceive Logo as a mere technological tool rather than an innovative approach that encourages individuality and autonomy. The Logo approach implies self-consciousness -to be oneself-, to be in control -to be the owner of oneself-, and self-decision -to act by oneself-. These human attitudes require “personal reflection” and demand “thinking about thinking.” Because these traits are not encouraged in today's society, they pose an obstacle to Logo's continuous expansion. Better Logo versions and explanations of its meaning, the increasing number of people that have had the experience and pleasure of thinking and creating with Logo in their childhood, the evolution of society to better human life conditions, will gradually produce the necessary changes for Logo's due appreciation and continuous success.

Logo in Australia: A Vision of Their Own

by Jeff Richardson

Jeff Richardson is a lecturer in Educational Computing at Monash University, and a Research Fellow in Information Systems at RMIT, in Melbourne, Australia. He commenced his career as a primary teacher, and began classroom based research with children and computers using the first commercial versions of Logo in the early 1980s. His ongoing research interests are programming as an expressive medium for children, and home-schooling. Jeff also hosts a national weekly radio program, "The Coodabeen Champions."



The history of Logo in Australia begins in 1974. Scott Brownell, a teacher from the island state of Tasmania brought a magnetic tape copy of Logo from MIT to Hobart, to run on a PDP-11 at the Tasmanian Education Department's computer center. He then recruited another Tasmanian teacher, Sandra Wills, and secured a rare and expensive robot turtle from The General Turtle Co. The ensuing project saw every school in Tasmania connected, with a teletype terminal, to the PDP-11. Sandra would load the turtle into the boot of her car and travel all over the island, moving from school to school. At each school children would hook up the turtle to their terminal and use their remote Logo to control it. It's quite astonishing to think that some of these children are now in their 30s!

PEOPLE AND SMALL COMMUNITIES

Like this beginning, the story of Logo in Australia since has been one of people and small communities, excited and motivated by the Logo idea. It's an idea that for all its power is often tacit, and hard to define. Because of this, where you find Logo, you often find a champion; someone who has taken the Logo idea and used it in making a vision of their own. Sandra and Scott were certainly two such champions.

Their vision though, needed a community to find its expression. Tasmania is small, relatively isolated, and remote. It might seem odd that such a place should be one of the pioneer settings for Logo, but there are some things in its nature that find resonance with subsequent Logo successes and developments. Being a small and isolated community, Tasmanians have a particular sense of belonging, identity and community. While this is something that seasoned Logoists will immediately recognize and value, being small and self contained has other more pragmatic advantages. It's just plain easier in such a setting for energetic champions to carry a whole system along with them, and to obtain the establishment

endorsement and support that can supply both the necessary resources, and even more importantly, some degree of civic mandate or imprimatur.

The initial Tasmanian Logo project evolved into a state-wide initiative to place personal computers in all the schools in the state. The point of these computers was to provide children and their teachers with constant, easy access to Logo as a learning medium.

PERSONAL COMPUTERS AND THE LOGO VISION

By the early 80s, personal computers, then going under the now seemingly quaint name of "microcomputers", had established a real commercial presence. The Tasmanian project saw "banks" of microcomputers placed in every school on the island. Such a commitment to computing for children grabbed the attention of the rest of the country. Progressive educators and computer specialists were keen to become involved. And in scattered places, on smaller scales, people began emulating and reinterpreting the Tasmanian Logo experiment, creating a demand for intellectual and technical resources.

This led to two technical breakthroughs in global Logo history. With the arrival of the Apple, Personal Computers came to rule the earth and distributed computing went into hiding for 15 years. Richard Miller, of the University of Wollongong in NSW, wrote THE first version of Logo to run on the Apple, specifically to drive the robot turtles in the Tasmanian project. In addition to collaborating with Richard, Sandra Wills had overseen the engineering of a small and relatively inexpensive floor turtle, the TassieTurtle. The TassieTurtle achieved a degree of accuracy and precision that had eluded similar R&D efforts in Edinburgh and elsewhere. And it could be run from a 5.25 inch floppy disk on an Apple. Once Terrapin and LCSI Apple Logos became commercially available, Tony Adams of RMIT in Melbourne, Victoria, was quick to provide low level code procedures to enable

both to control the TassieTurtle. When Seymour Papert visited Australia to speak at the Victorian Computer Education Conference in Melbourne in 1981, he was moved to tears when he found himself in a room surrounded by a swarm of buzzing, beeping robot turtles.

Seymour's visit built on the pioneering work of the Tasmanians to inspire a generation of Australian Logoists. Logo veterans still remember Seymour's dazzling demos using TI Sprite Logo, a version capable of degrees of parallelism and playfulness only recently reached once more in MicroWorlds and StarLogo.

The Logo pioneers who came after the Tasmanians were scattered across the country, with the largest concentration in Melbourne, Victoria. Computers, and computers in education, were in vogue in the early 80's. And Logo and Logoists were to benefit from this. Not all interest though, in computers, or computers in Education, shared the Logo vision. People were drawn to Logo and the Logo community from a wide range of backgrounds and disciplines. Many were teachers and educators, but of all stripes: Primary, Secondary, Tertiary, Sciences and Humanities. Many were not professional educators at all, but parents and even some home schoolers.

What motivated them, and unified them loosely into a community during this time was a yearning for a child centered, non-trivial, and authentic approach to education. These ideas, which share an epistemological landscape with a tradition going back at least as far as John Dewey and A.S. Neill, are at best latent in Logo. For some, Logo came as a mediation for these ideas and yearnings. Yet for others, experiencing Logo as a personal learning experience, often combined with a confronting engagement with the power and subtlety of the ideas in *Mindstorms*, was something of a conversion experience, resulting in a radical shift in their views on education.

By 1984, Anne MacDougall of Monash University, Melbourne, was able to convene a conference entitled

“Logo in Australia; Ten Years on.” This title was a recognition of a decade's work since the beginning in Tasmania. The conference was attended by Logoists from all over the country. The diversity of the people in attendance; teachers, students, academics and parents was matched by the panoply of Logo versions and platforms that were in use at this time: Commodore 64, Atari, Tandy, BBC and TI contended with LCSi and Terrapin's Apple versions. Logo had become widespread and its enthusiasts had an energy and optimism that belied their limited resources. Everyone was working with not many machines and not much time. Although the educational establishment could not now ignore Logo, Logoists were still very much a guerrilla element.

LAPTOPS AND LOGO

The next big leap forward for Logo in Australia did not come for another five years. During this time LogoWriter and LEGO TC logo were previewed, then commercially released, to critical acclaim. Though successful, this success was limited, not by any limitation in these products themselves, on the contrary. They were too good. Here was the Logo idea so plainly expressed, an all encompassing, project based curriculum, “pages”, now ubiquitous years ahead of time. But to really use these Logos could only be done with an educational revolution. It was not forthcoming and it seemed that Logo had reached a high water mark.

The fashions in educational computing had moved on. Many had come to view Logo as a fad that had passed, and view it's proponents as impractical dreamers, refusing to face the realities and demands of mass, industrial scale education in the late 20th century. Computers in schools were to be about “information technology” and have a decidedly vocational and utilitarian role.

Then, in 1989 a curious and uniquely Australian development began which was to be the strongest vector for the

spread of Logo in Australia yet. Liddy Nevile, a long standing member of the Logo community, in conjunction with The Royal Melbourne Institute of Technology and the Australian Council for Educational Research began the Sunrise Project. The key element of this project was laptop computers. In the pilot schools where it began, Coombabah on the Gold Coast in South East Queensland and Methodist Ladies College in Melbourne, entire cohorts of children between years five and seven were given laptop computers. One per child. And each machine was loaded with LogoWriter, only. And the entire curriculum was conducted and expressed by the children as LogoWriter projects.

This project was audacious. In 1989 laptop computers were rare and expensive, and brought with them technical and maintenance demands that seemed beyond the resources of even a well endowed Private School. But even more audacious was the reason for using them. Logo. The rationale presented to the education community for attempting this project amounted to a deliberate, radical reform of conventional schooling. It seemed to many at the time to be an extremely risky venture.

As anyone in the Logo community might guess, it couldn't NOT succeed. The children did everything, Geography, Ancient History, Biology, Music...expressed as LogoWriter projects. The imagery of children with their personal laptops captured the imagination of both lay people and educationists nationwide. This popular success was almost inescapably technocentric. But this factor had an interesting twist. Schools which wanted to emulate the project (there have been scores and the number is still growing rapidly) tended to swallow the thing whole. The laptops were the shiny baubles that attracted the interest, but as nobody really knows what to do with computers in education, LogoWriter, and now MicroWorlds, became the default software for laptop initiatives all over the country.

In the ten years since "laptop schools" have become very widespread. They are predominantly, but not exclusively, Private Schools. The more the concept has spread, so the Logo philosophy informing the initial project has become distorted and diluted.

There are many schools that have built on the MLC experience to elaborate a constructionist, computer mediated curriculum. Kilvington, also in Melbourne, has made robotics a centerpiece of its program. John Paul College in Brisbane, Queensland, another school that was quick to emulate the MLC "MicroWorlds and Laptops" approach, was an innovative early adopter of the Internet, wiring the entire school.

These successes were all in schools that had visionary leadership and strong, communal sense of purpose. But these successes also received a great deal of public interest and acclaim. From a mainstream media point of view though, the laptops were the most visible, and easiest to communicate, aspect of this innovation. The role of Logo is more complex, difficult to explain, and dependent on a detailed understanding of how those school communities work.

The success though was undeniable, and as Private Schools in Australia are basically, if discretely, in competition with one another, they mostly now can't NOT have a "laptop program" of some kind. This imperative has meant a resurgence in technocentrism in the way laptops have been introduced and used in many of these schools. As a result, fluency with current office automation software has come to the fore as an educational goal, and displaced Logo and MicroWorlds in many children's experience.

PUBLIC SCHOOLS: A FRONTIER FOR LOGO

The frontier for Logo in Australia has now shifted back into the Public School System. The sheer weight of

numbers of computers in the community, and the amount of everyday computer use, has placed expectations on the Public System. These expectations can only be met by schools having enough machines. At last, Public Schools are starting to get enough machines. The machines are coming from two very different sources.

With the current vogue for the Internet, the government is allocating extra resources to Public Schools so that they might get connected. At the same time, the rapid obsolescence of computers has meant that many Public Schools are benefiting from gifts of large numbers of corporate and institutional office machines that would otherwise have been scrapped...machines that are perfectly capable of running MicroWorlds.

It's an exciting time for Logoists in Australia in 1998, as teachers can finally see the possibility of having enough computers readily available to make a Logo-mediated curriculum an everyday reality for children.

Typical is the school that my own children attend. It's an averagely endowed, public primary school. The school has had computers for over ten years. And for all that time the school has "had" Logo. But it has never been able to use Logo (or any other software) in any non-trivial way because the number of machines, about one for every 25 children, was so low. Teachers who were committed to a child centered approach to learning simply could not see the value of Logo in such a computer-poor context. They were understandably skeptical of perennial "latest and greatest" pitches on behalf of new software or new machines.

This has changed dramatically. The school now has lots of machines, but hardly any of them are new. Corporate and institutional donations of superseded computers, supplemented by carefully targeted purchasing of second-hand machines, has meant that the teachers have enough computers at their disposal to realistically attempt mediating the curriculum through computers. And MicroWorlds is a

natural software medium of choice. It has been taken up with enthusiasm. The teachers want more computers in order to make MicroWorlds available to the children.

Many Public Schools across Australia are currently undergoing similar experiences, and it makes an intriguing contrast with the more widely publicized "laptop schools." Even in the most visionary and innovative Private Schools, where the "laptop revolution" was forged, the laptops themselves, being such visible icons of technocentrism, acted as something of a Trojan Horse for the relatively spartan Logo software concealed within them.

Curriculum in Australia's Public Schools is committed to the promotion of critical thinking, to the support of varied learning styles, and to the rights of equal access. So, as I've said above, MicroWorlds is a natural choice of software, embodying as it does, a process, and child-centered approach to learning. Teachers and children don't particularly care if their computers are old and beaten up, as long as they have enough of them to make pursuing this type of work possible.

For the first time, they DO have enough of them. The history of Logo in Australia is perhaps only just now beginning.



The Constructionist Approach: The Integration of Computers in Brazilian Public Schools

*by Maria Elizabeth
B. Almeida*

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This chapter will discuss the implementation of computers in Brazilian public schools — from a few isolated university trials to the first national program when Logo was introduced circa 1983 to the present day. Despite the current widespread availability of computer hardware and software, the use of computers within the educational system is, for the most part, restricted to a practice in point or to computer classes. The chapter concludes with a reflection on the possible causes for this lack of integration of computers in the pedagogical process, pointing out the fundamental need for adequate teacher preparation.

IN THE BEGINNING

In the '70s, Brazil invested in the educational sector to support the introduction of computers to Brazilian society. While concrete results in the educational sector fell short of expectations, researchers at Brazilian public universities continued to experiment with the use of computers in education.

The “Universidade Federal do Rio de Janeiro - UFRJ”¹ was the first Brazilian institution to employ computers in education. Initially, computers were used as an academic research rather than pedagogical tool. However, in 1973, UFRJ, through “Núcleo de Tecnologia Educacional para a Saúde/Centro Latino-Americano de Tecnologia Educacional para a Saúde - NUTES/CLATES”², used computer simulations for teaching chemistry in the health sector and hospital management (Andrade & Lima, 1993).

1 Federal University of Rio de Janeiro

2 Center for Technological Education for Health/Latin-American Center for Technological Education for Health

THE EDUCOM PROJECT

The use of computers for educational purposes was introduced to the public school system in the '80s when the “Ministério da Educação e Cultura - MEC”³ supported the EDUCOM project. Pilot-centers researching the use of computers in education were created in five public universities. Each center adopted a specific pedagogical approach, associated with either educational software or with the use of computers as a tool for project development and problem resolution. Of the five centers, two were distinguished for the employed the constructionist approach: the “Núcleo de Informática Aplicada à Educação - NIED”⁴ at the “Universidade Estadual de Campinas - UNICAMP”⁵; and the “Laboratório de Estudos Cognitivos - LEC”⁶ at the “Universidade Federal do Rio Grande do Sul - UFRGS”⁷.

The EDUCOM project was conceived and operated according to suggestions from Brazil's scientific community, which set a new tone in terms of public policy. Unlike to what happens in other countries – as in the United States, for example, the educational concern is mainly with computer literacy, whereas in France, the focus is on promoting mathematical ability and logical thinking in students. In the Brazilian project, on the other hand, the computer was perceived as a catalyst to bring about pedagogical changes (Valente & Almeida, 1997).

This educationally innovative perspective (Andrade & Lima, 1993) was concerned with the development of critical reflection and marked a change in the educational approach — from one centered in teaching and the transmission of knowledge to a pedagogical practice that

3 Ministry of Education and Culture

4 Center for Informatics Applied to Education

5 State University of Campinas

6 Laboratory for Cognitive Studies

7 Federal University of Rio Grande do Sul

prioritized the learning process and the construction of knowledge by the student. All The five pilot-centers for the EDUCOM project developed their investigations centering in the use of computer by the students in the learning process. (Valente & Almeida, 1997).

Despite the potential for educational transformation, the EDUCOM project limited itself to the implementation of the five pilot-centers and public school experiments (Andrade & Lima, 1993). While sweeping changes in the educational system failed to materialize, the ideals of the project continue to be disseminated by a loyal body of researchers.

THE FORMAR PROJECT

In 1987 and 1989, UNICAMP offered Computer for Education courses (FORMAR project, sponsored by MEC) at the post-baccalaureate level to 100 teachers participants like students from across Brazil. The goal was to establish computer centers in every state of the country and to use computers as a pedagogical tool and to act as trainers to other teachers. The development of the activities these courses counted with one teaching staff coming from the institutions with relevant experience in the area.

Participants were provided with a perspective on the different kinds of theory and practice being developed in Brazil, with emphasis on the Logo approach.

They spent two months learning how to master the technology, studying the underlying educational theories, and formulating proposals for bringing computer centers to their own institutions.

While these courses marked a milestone in Brazilian public education (Almeida, 1996), teachers graduates had to contend with a number of drawbacks. First was the inherent conflict between the imposed structure of the courses (the institutionalized criteria for grading, curriculum, etc.) and constructionist theory. An even greater

challenge was the excessive number of hours of class a day, with 360 hours being completed in two months. This compression of time made it difficult to assimilate the material and to allow for more in-depth explorations.

A further difficulty lay in the diverse computer backgrounds of the participants, which hindered rapid proficiency with the software while at the same time enriching the discussions with different points of view and styles of exploration (Almeida, 1996).

Finally, theoretical studies centered mainly on Papert's and Piaget's theories to the exclusion of other thinkers such as Vygotsky, Dewey and Paulo Freire, whose ideas would have shed additional light on the educational use of computers.

At the end of the FORMAR project, graduates attempted to implement the "Centros de Informática Educativa - CIEDs"⁸ in their home states. Yet their efforts were impeded due to the political structure of their institutions, as well as the lack of appropriate equipment.

Eventually, the majority of the centers were set up, and graduates began to train other teachers and to offer free courses for students, using open-ended software such as text editors, computer programming languages such as Logo, and educational software such as CAI (Computer Aided Instruction). Although most of this activity lay outside the realm of the classroom, new interest in computers was stimulated while the contents and methodologies dealt with in the FORMAR project were widely disseminated.

The FORMAR project has since been successfully adopted as a training model in various contexts (Barrella & Prado In Valente, 1996), although it has had to be adjusted according to the specific needs and interests of new training groups.

⁸ Computer Education Centers

THE EDUCOM-UNICAMP PROJECT

Unlike CIEDs, the universities employing the EDUCOM project developed pilot programs within the school system. An example is the EDUCOM-UNICAMP project, started in 1985 and implemented at two public schools, including the EEPSEG João XXIII. Using Logo programming language and methodology, teachers facilitated the interaction between students and computers while helping students implement projects related to the contents of each school subject.

The Logo classes at this school were taught during regular class time at a computer laboratory set up in two classrooms. Groups of students took turns between the two computer labs, providing equal access to the computers. Eventually, the two labs were merged with an adjacent classroom, joining all the rooms into a single space.

Initially, teachers at EEPSEG João XXIII felt threatened by the ease with which students interacted with the computers. While teachers attempted to control the learning process according to traditional pedagogical principles, students were surpassing them in their mastery of the computer language.

In weekly meetings, the teachers realized that they were threatened by the newness of the process and that it was time to review their values, concepts and teaching styles. In an attempt to fine-tune their own performances, they became more autonomous within the Logo environment, changing the methodology, making it more flexible, and providing students with the necessary information, according to the demands of their projects.

In the end, conflict gave way to cooperation, with teachers and students acting as partners in the learning process. For those teachers able to rise to the challenge, “the EDUCOM project is, and always will be, a path leading to new pedagogical approaches, leading to new methodologies”. (Oliveira at alii, 1993: 393, 386).

THE EDUCOM-LEC PROJECT

The EDUCOM-LEC, Project at “Laboratório de Estudos Cognitivos”⁹ at “Universidade Federal do Rio Grande do Sul - UFRGS”¹⁰ conducted cognitive studies based on genetic epistemology. Trained in the Logo environment, teachers applied the clinical Piagetian method to promote autonomous learning in children. Research conducted by LEC had three axes: basic research (which investigated interactions with computers), researcher development and educator development (Andrade, 1993).

New researchers were trained according to the practice employed by the International Center for Genetic Epistemology in Geneva. Here undergraduate students beginning their research training worked alongside more experienced researchers, promoting cooperation between the two groups and encouraging autonomy in the less experienced group. Grounded in the research modalities, the teachers’ training was carried out through service training and post-baccalaureate courses.

Initially, the hub of the LEC project was in the “Centro de Preparação e Iniciação à Ciência da Informática - CEPIC”¹¹, where the Logo environment was employed to promote cognitive, affective and social development. In an attempt to decentralize operations and to bring computers closer to the students, in 1987 sub-centers were created at both the pre-school and the primary school levels (from grades I to IV).

Throughout the research project, teachers with different educational levels and backgrounds were integrated with researchers and people with computer training. This assimilation favored a reciprocal exchange among participants and promoted the development of individual competencies.

9 Laboratory for Cognitive Studies

10 Federal University of Rio Grande do Sul

11 Center for Preparation and Initiation to Computer Science

The Logo environment called upon teachers to exercise a new role as facilitators of students' learning. The teacher helps facilitate the student's cognitive development through questioning that challenges preconceived notions and introducing the student to heuristics — a learning process that encourages open-ended exploration and individual styles of thinking (Petry & Fagundes, 1992; Almeida, 1996).

Teacher-facilitator training took place during programming activities, observation of students, and seminars involving theoretical discussions. This broad range of activities enabled teachers to experience situations from a learner's perspective and encouraged them to become aware of their own learning process.

In the early 1990s, LEC drew on Jean Piaget's psychogenetic theory to investigate socio-cognitive interactions of people communicating via telematic net. The same time, LEC's current focus of study is on the processes of presentation construction, using a multimedia environment for learning.

WORKING WITH CHILDREN AT SOCIAL RISK

Children at social risk is the Brazilian phrase for children and adolescents who live or work, often to support their destitute families, on the streets of large cities. Easy prey for criminals, they are at constant risk of becoming criminals themselves.

In an effort to provide socio-educational assistance to children at social risk in the city of Brasília, in the '80s the public educational system in the federal district created a program called "Promoção Educativa do Menor - PROEM"¹². It is supported by the Educational Foundation and run in the Parque da Cidade School. Among the typical problems identified among children at social risk

12 Educational Promotion of the Underaged

between the ages of 10 and 18 are learning difficulties and poor school performance.

Adopting the principles of genetic epistemology, the PROEM initiative is directed towards individualized student attention, taking into account the individual needs and life experiences of the child on the streets. Students may join the school, which offers eight grades of fundamental studies, at any time of the school year.

In 1989, the project "Educação Científica para os Meninos de Rua de Brasília" (Science Education for Brasília's Street Children) was launched at the Parque da Cidade School. Its aim is to promote the use of computers in educational activities to awaken an interest in learning and to pave the way for the student's professional development (Valente, 1993b). The computer, together with Logo methodology and applications programs (text editor, electronic spreadsheet, data base manager), are used as tools for problem resolution and project implementation. The curriculum is tailored to the individual needs of students, according to personal interests, styles and levels of development.

Teachers, administrators and researchers tracking the progress of students in the program report an increase in self-respect and motivation to learn, along with an acquisition of the necessary groundwork for a professional career in the field of computer science (Valente, 1993b; Macedo & Suguri, 1992).

A case in point is 26-year-old Juracy, who presently works as a computer assistant and hosts programs at a community radio station. Juracy came with his family (parents and five siblings) from a small city in the Northeastern dry lands to live in one of the cities around Brasília. Although abused by his father, Juracy worked as a car attendant at a grocery store parking lot to help support his family. At 9 years of age, the illiterate child joined PROEM and was soon recognized as a diligent student.

When the project “Science Education for Brasilia’s Street Children” was launched, Juracy was chosen for a teaching assistantship, which he combined with his studies and work (Valente, 1993b). As a teaching assistant, he specialized in Logo, developing free programs using the Logo language, including a simulation of the solar system.

While not every PROEM graduate has achieved the same degree of success as Juracy, most students were strongly affected by their experience at the school. In the case of Ronaldo, who was undisciplined, aggressive, and plagued by learning difficulties, the Logo environment helped him to become more cooperative, independent and self-confident. The ordered programming world enabled him to create his own private microworld, where he felt more secure and in control (Valente, 1993b).

THE DISSEMINATION OF EDUCOM AND OF FORMAR

The EDUCOM and FORMAR projects were implemented at research centers and then branched out to the educational system as experimental pilot programs. The introduction of computers at public schools brought about a bold proposal for changes in the educational process. This new perspective, in contrast to the prevailing technocentric view of the ’60s, caused some discomfort in observers of Brazilian education.

Once this initial resistance was overcome, there followed a period of stagnation in terms of public policy and investment, which lasted until 1996. At the same time, a line of IBM-PC compatible microcomputers was launched in the national market, rendering obsolete existing equipment and software. Many projects already underway also came to an abrupt halt, all of which prompted reflection on the possibilities of continuity and the search for new paths.

At the same time that several educational institutions abandoned their computer studies, others took the initiative to delve into the field. Some universities created

disciplines for the study of the pedagogical use of computers at the undergraduate level, while others established interdisciplinary studies on new technologies and education. A case in point is the strictu-sensu post-graduate program offered at the “Universidade Católica de São Paulo – PUC”¹³ and the “Universidade Federal do Rio Grande do Sul – UFRGS”.

JOINING FORCES WITH OAS

In recognition of the innovative Brazilian plan for the integration of computers into the educational system, the Department for Educational Studies of the Organization of American States (OAS) invited Brazil’s Ministry for Education and Culture (MEC) to propose a project for multinational cooperation among Latin American countries.

The multinational project for Computer Sciences Applied to Elementary Education encompassed eight countries and was approved by OAS in 1989. With Brazil in the leadership role (Petrópolis, 1989), the project spanned five years (1990-95), but was suspended in 1992, due to a lack of resources that prevented Brazil from paying the annual dues.

The dual purpose of the project was to identify common concerns in terms of research and human resources development for the implementation of computers in education, as well as to secure subsidies for the expansion of the multinational project. From these initiatives emerged the principles underlying the cooperative venture: participation, integration, solidarity, diversity and respect for different cultures (Moraes, 1997).

¹³ Catholic University of São Paulo

NEW CHALLENGES

As mentioned at the beginning of this chapter, the use of computers for educational purposes in Brazil was launched by the EDUCOM and FORMAR projects. As a result of the FORMAR project, computer centers devoted to the training of school teachers and to the promotion of courses in the public school system were established in most states. Despite the lack of new investments and programs from the federal government, new initiatives for computer education multiplied, reaching other sectors at the municipal level and within private institutions.

Until the appearance of IBM-PC compatibles, CAI and Logo language software were used in conjunction with 8 bit computers. The widespread growth of microcomputers invalidated the existing educational software and deprived the Logo working groups of software to use with the new equipment. The production of educational software was put on hold until a translation of foreign software into Portuguese became available.

The Windows environment posed additional challenges to researchers working with a constructionist approach. Questions emerged, such as how to adapt mouse clicks to Logo programming and how to continue drawing with a turtle in light of modern drawing editors such as Paintbrush. These explorations led to a more in-depth examination of the constructionist approach, which was tested in computer environments outside the realm of Logo. The result was the creation and the application of the description-execution-reflection-debugging cycle detailed by, among others, Papert (1985, 1994), Valente (1996, 1993a), Prado (1993) and Almeida (1995, 1996).

THE FIRST LOGO STUDY GROUP

The aforementioned questioning gave rise to the “1º Grupo de Estudos Logo”¹⁴ at UNICAMP-NIED in March of '94. Discussion revolved around the role and training of teachers in the Logo environment and the characteristics of the Logo language. To prepare for the two-day meeting, each participant was requested to write one or more essays, exploring the topics to be discussed. The essays were sent to the participants in advance so that they could familiarize themselves with different perspectives prior to the meeting.

At the meeting, the principal emphasis was on clarifying the function of the teacher in the Logo environment and setting training procedures and performance standards. After the meeting, the essays and seminars were published in the form of a book entitled “O professor no ambiente Logo: formação e atuação” (*The Teacher and the Logo Environment: Training and Performance*), edited by José Armando Valente.

Below are the main ideas advanced by the participants in the study group, whose collective knowledge, enriched by individual study and related experience, is of fundamental importance to future investigations.

The primary role of teachers working with the Logo approach is to facilitate the student's learning process, which marks a departure from the traditional classroom role of a teacher (Fagundes In Valente, 1996). In acting not as an instructor, but as a guide to students' learning through exploration and individual discovery, the teacher redefines the goal of teaching (Bustamante In Valente, 1996).

This innovative view of the teacher's complementary role in the learning process demands a shift in training. In order to realize Papert's view of the learner as the builder

14 First Logo Study Group

of knowledge, the teacher needs adequate preparation in the constructionist approach. This implies familiarity with the intertwining of theories related to the construction of knowledge, such as those of Piaget, Vygotsky, Paulo Freire and Papert (Almeida, 1996).

Methodology specific to the Logo environment must also be acquired, according to the action, reflection and debugging cycle (Valente, 1996). Teachers must consider the different levels of reflection to allow for the assimilation of concepts, strategies and computer techniques, while conducting an analysis of computer bugs and the subsequent debugging.

The constructionist approach reaches beyond computational boundaries (Bustamante in Valente, 1996) to transform the educational process. In an environment that prizes dialogue, students learn to test and reformulate hypotheses and to build and re-build knowledge, all the while embracing ongoing technological development. (Fagundes in Valente, 1996).

NEW DIRECTIONS

In light of the fact that the Logo approach is a novel way of using new technology for educational purposes, an attempt has been made to apply constructionism to other pedagogical practices involving the use of open-ended software, such as authorship programs, text processors, design editors, electronic spreadsheets and data base managers.

Applying this approach to the relevant software, students may teach the computer how to develop a presentation on a specific theme, how to solve a problem situation, or how to implement a project. The student — active builder of his or her own mental structures (Papert, 1985) — constructs knowledge in accordance with the topic under study. The computer, guided by the student, allows for the

integration of content and promotes the development of new and more complex thinking structures.

The teacher, no longer a transmitter of information, acts as the student's mediator, facilitator and consultant. In a flexible partnership with students, the teacher questions and challenges them, welcomes their collective input on selecting topics for study and setting targets, and invites them to verbalize their difficulties and discoveries. In this atmosphere of freedom and responsibility, students develop creativity and autonomy as they construct their own knowledge through experimentation, error and reflection.

In order to create this environment, the teacher must have the opportunity to analyze and re-elaborate their own pedagogical practice, respecting individual styles. This is only viable through a process of continuous training that articulate the abilities required for the computer with pedagogical practice and educational theories.

THE PROINFO PROJECT

In 1996, MEC established the “Programa Nacional de Informática na Educação - PROINFO”¹⁵, which plans to implement computers in 13.5 % of Brazilian public schools with more than 150 students at the elementary and secondary levels. This program is distinguished from previous ones through its emphasis on providing underprivileged students in the public school system with computers.

Each state in the country has autonomy to define its own proposal. Schools wishing to apply to the program must submit to the “Secretaria Estadual de Educação”¹⁶ a proposal, detailing how the computers will be used as a pedagogical tool. Although there are no set guidelines on theoretical concepts, most state projects focus on the

¹⁵ National Program for Computer Sciences in Education

¹⁶ State Secretary of the Education

attainment of knowledge through the development of curriculum-related thematic projects, representing a change in the educational process.

“Núcleos de Tecnologia Educacional - NTEs”¹⁷, have also been created to serve as a training ground for teachers and as centers for the dissemination of experiences. The training of teachers multipliers of NTEs is comprised at the courses of post-baccalaureate of a minimum of 360 hours of courses that cover the fundamentals of education, the development of projects, and the pedagogical use of different software. Each course provides a different emphasis, but the underlying focus is on the use of open environments, such as text processors, data base manager, electronic spreadsheet, the Internet and different versions of Logo.

Since there are not enough teaching staff with experience in the pedagogical use of computers, courses of post-baccalaureate are frequently taught by a teacher from either the computer science or educational field. A dichotomy in practice may result, since these professionals often lack experience in both fields.

Presently, MEC, backed by the “Comitê Assessor de Informática na Educação”¹⁸ is engaged in a teacher development action that will re-orient activities in the new courses and in the classroom. The new proposals for groups under training should help create a better balance between theory and practice, action and reflection, computer expertise and pedagogical resources. Besides should contemplate to the teachers in training the opportunity of to act as observer and as mediator in activities using computers with students, so that they has ability to rebuild these experiences in your educational reality.

17 Centers for Technological Education

18 Supporting Committee for Computers in Education

COMPUTERS AT PUBLIC STATE OWNED SCHOOLS IN SÃO PAULO

Besides PROINFO (the National Program), some states are investing in similar projects with their own distinguishing characteristics. The “Programa de Educação Continuada – Inovações no Ensino Básico, PEC-IEB”¹⁹ at the state of São Paulo deals with computers in education as a subproject. Teachers are trained in the pedagogical use of computers through joint programs at universities, including the “Universidade Católica de São Paulo – PUC”.

Beginning in September 1997, the subproject “Informática na Educação” (Computers in Education) has offered weekly workshops in theory and practice at the school’s laboratory. The primary objective is to provide the teacher with an understanding that the computer is not a threat to his or her profession, but rather a tool to enrich the practice of teaching.

At first, teachers in training act as learners in relation to computers, creating scenarios and texts, producing journals and implementing projects. The activities are designed to promote the development of creativity, cooperation and self-esteem, and to encourage reflection on the learning and teaching process.

Teachers then move on to explore and analyze educational software of diverse theoretical backgrounds, reflecting upon their potential and limitations for use in pedagogical practice. Proposals for the use of computational resources for students are detailed with the emphasis on partnership and cooperation. Teachers also work together with students on creating interdisciplinary projects for the use of computers.

Such a collaborative approach on the part of teachers marks a radical departure from the traditionally directive

19 Program for Continued Education – Innovations at Elementary School (from grades V to VIII)

and instructional classroom format. This transformation of public schools is evident in the projects developed by these teachers in training. Take, for example, two projects implemented at EEPSPG Pietro Petri, located in the outskirts of a small town near São Paulo. The Photo School project was initiated by the Arts teacher, who began by exploring the history of photography. Next, he had students manipulate cameras and explore the software “Como as Coisas Funcionam” (How Things Work). Then, students visited a photo laboratory and, together with the teacher, created computer designs, texts and presentations.

At this same school, a group of teachers from different disciplines is developing a joint project with students on health and epidemiology. They interviewed the City Secretary for the Health Sector and are creating a computer map that pinpoints focal disease areas. After analyzing the project, the training group suggested the integration of the two projects (Photography and Epidemiology).

Teachers and students are visiting the locations and rural schools most prone to epidemic diseases, while suggesting preventive measures to people living in the area. They interview teachers and students at the schools, collect data and take photographs on location. They will then convert the data collected into tables and graphs, interpret the results, and develop projects using MicroWorlds to disseminate the information. The goals of the project are to eradicate the disease-causing insects and determine ways to improve sanitary conditions and the local quality of life. Once solutions are formulated, a campaign will be launched using computer-generated billboards, newspapers and leaflets to mobilize the community to combat the epidemic diseases.

The perspective of the subproject Computers in Education is educational change. Teachers must not only carry out project-related activities, but must also organize study groups for the exchange of experiences, as well as to

assume responsibility for their own training and development.

FINAL CONSIDERATIONS

Rather than attempt an exhaustive analysis of the use of computers in Brazilian public schools, the present chapter has focused on the constructionist approach within the educational system. Although the Brazilian initiative was innovative in nature, none of the public programs effectively transformed the teaching-learning process due to the complexity underlying the pedagogical use of computers.

Among the diverse factors required for the successful integration of computers in education are the availability of equipment and software, solid political-pedagogical support, a new educational perspective that redefines the concepts of teaching and learning, and, above all, the key role of the teacher.

In linking up with universities, the public programs have recognized the importance of teacher preparation. Current training covers not only computer knowledge, but also the ability to select the software most relevant to pedagogical objectives and to create learning environments that favor the construction of knowledge.

The Logo programming language, available in different versions, is one such effective learning environment. Students acquire knowledge through the employment of the description-execution-reflection-debugging cycle, which can also be applied to a wide range of software — from authorship programs and text editors to electronic spreadsheets and data base managers and in the interactions and programming provided by the distance communication environments.

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Project Lighthouse in Thailand: Guiding Pathways to Powerful Learning

by David Cavallo

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Project Lighthouse in Thailand is an ambitious attempt to utilize computationally rich environments to highlight new paths to learning. Although the project includes many different situations scattered throughout Thailand and has goal of providing concrete examples of powerful learning environments in the digital age, the project does not pretend to be a blueprint for education. Rather, the intention of Project Lighthouse is to create a small number of pilot projects, each of which represents a more radical change in learning conditions than could be envisioned within the structure of an existing school. Each project is different enough to make a real contribution. We aim to use these projects to provide educators and the public with models that can break their mindsets about what education must be.

We began conceiving the project in early 1997. A group of Thai industrialists, educators, and government officials had come to believe that the considerable economic success Thailand had achieved in the previous decade could not be sustained unless the educational system could help develop learners who could function productively in a global, knowledge-based economy. They further believed that trying to incrementally reform the school system would take too long, cost too much, and still leave them, after perhaps twenty years of effort, with the same problems the rest of the developed world has now. They sought radical improvement and results. Thus, they approached Seymour Papert and his group at the MIT Media Laboratory to help design and implement such alternatives. The MIT group, together with the Thai group under the direction of the Suksapattana Foundation and funded primarily by the ThaiComm Foundation, began planning for the project.¹

Prior to the development of this partnership many directions for educational reform had been explored. There were many ideas about how to begin. Naturally, most started with some aspect of reforming school. Suggestions ranged from placing some computers in each school or

adding a computer course curriculum to slightly more radical ideas. But each suggestion had to fit within the existing format of school, with its established culture, habits, schedules, measures, courses, texts, and way of life. The proposed education reform could be summarized as adding computers into an already crowded mix. There also was the tendency to proceed broadly, across the whole country.

The new collaboration broke with these ways of thinking. While proceeding broadly across the whole country was admirable in its goal for equity, it was problematic: if the primary goal was to show what was possible, then going deeply was more important than going broadly. We decided that the best path for eventually reaching everyone in powerfully meaningful ways was to initially place a large amount of resources in very few sites with the intention of showing deep change. These concrete models then would serve as exemplars to induce broad changes. The group also decided to focus some of the early attempts on those for whom, for the most part, school has failed. This included those in rural or poor economic areas, and with children deemed *at-risk*.

School, like any large institution, has developed its own culture and its own *grammar* (Tyack and Cuban, 1995). Like most institutions, school becomes resistant to change. School meets reform by rejecting it or assimilating it, changing the reform more than changing itself.

1 The primary funding was supplied by the ThaiComm Foundation, as well as from Siam Commercial Bank, although the Suksapattana Foundation, named by the King of Thailand and meaning roughly “the foundation for the development of learning” coordinated the project in Thailand. The project has been led in Thailand by Khun Paron Isarasena na Ayudhaya,, with the leadership assistance of primarily Anita Horton, Dr. Bupphachart Tunhikorn, and Khun Bangkok Chowkwanyun, along with Dr. Dumrong Kasemset, president of Shinawatra Satellite Company. So many others have been involved it is impossible to name them all. Yet the nature of this project is that its development and success depends upon the contributions and development of all participants.

Rather than re-designing a new school from the top down, we employed a kind of biological metaphor, trying to create many small examples, and examples within examples. In this way, each pilot site was to be different from each other. Even different groups within the same pilot site could differ. The hope was that many new and unexpected ideas and activities would emerge, better than what could have been planned beforehand. The sites would examine and cooperate with each other, so that the good ideas could spread and each site could adopt what they like based upon the local situation.

We hoped that from a strong core set of principles, beliefs, and practices, many new developments would take place. What was centralized was the philosophy. What was decentralized was the practice and decision making among the learners. The participants would meet periodically to discuss, assess, and share ideas. A core set of Fellows (now called Constructionists) would take on the research, mentoring, and dissemination responsibilities.

As of this writing, there are five pilot sites in Thailand with quite a number of additional sites due to come on-line in 1998. Three sites are in urban areas and two are in remote and impoverished rural areas. While in some sites, everyone is working together, in other sites, there are several distinct groups of students working as independent units. Each of these sites is developing uniquely. Even within a site of multiple groups, each group is developing uniquely. Indeed, this flexibility over standardization is a goal and a successful result within Project Lighthouse. Just as we believe that learning proceeds more deeply and effectively when individual learners are free to pursue their own interests, so too can each site develop more productively when free to conform and adapt to the learners and their situations. In this article I will not describe each site, but will draw salient elements from various groups among them.

CONCEPTUAL OVERVIEW

The theoretical framework for the design of Lighthouse projects draws upon three lines of thinking about education, extending and combining them in a unique integration.

- First, this work is most directly related is *the evolution of the Logo idea*. Project Lighthouse belongs to the tradition of Logo project implementations, but differs from most in several dimensions (although of course in each case there are a few significant exceptions):
 - Most strikingly, Lighthouse is not a school-based project.
 - The majority of learners are older than in most Logo implementations.
 - The concept of project-based learning that runs through all of the better Logo implementations is extended and enriched.
 - The new concepts of *Constructionism*, *technological fluency*, and *immersion learning* articulate trends that have been present in incipient form in earlier Logo work but are taken further here.
 - The connection with the subsequent two lines of thinking is itself an important feature.
- The second line of thinking relates to *the theoretical and practical approach of Paulo Freire*, augmented by the use of modern computational technology. The use of technology is important on two fronts: one, aiding discussion, reflection, and brainstorming about the issues, and two, designing and implementing the actions.
- The third line is *the connection of the content of curriculum change with the understanding of the process of change and the resistance to change in education*.

The project presented here is based on experiences that show how computer technology can be used to create conditions for radically new ways of learning characterized by:

- Giving students greater control over the learning process with the result that they learn to take charge of their own learning.

- Making the learning of all subjects more personal and more meaningful to the learner with the result that learning is better motivated and far more effective.
- Extending the content of what is learned to include the study of computer and other technologies.

The concept of *Constructionism* as developed by Seymour Papert and his group at MIT has provided a powerful, concrete basis for thinking about and creating learning environments. The idea as expressed by Papert is:

We understand “constructionism” as including, but going beyond, what Piaget would call “constructivism.” The word with the v expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the n expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable ... a sand castle, a machine, a computer program, a book. This leads us to a model using a cycle of internalization what is outside, then externalization of what is inside and so on. [Seymour Papert, Introduction, in Constructionist Learning, Idit Harel, ed., MIT Media Lab, 1990]

Constructionism proved to be an idea that people could grasp and use as a basis for guiding activities. Often people know what they do not like about existing learning environments, but do not have any practical concrete principles on which to base action. People knew how school often left students listening or watching others, or performing tasks of no interest and little value. Constructionism provided a lens through which Lighthouse participants could think about other ways of organizing learning environments. Through the teachers' experiences in workshops based on Constructionist ideas, they were able to re-think what they would like to do

themselves and with the learners. Constructing meaningful artifacts and projects would be the core activities within Lighthouse.

Each site begins by using MicroWorlds Logo to help develop *technological fluency* among the participants, both staff and students. Technological fluency, as coined by Seymour Papert, is the ability to use technology fluently, in the way that one is fluent with language so as to express thoughts, create artifacts, communicate with others, and realize ideas (Papert and Resnick, 1991, Cavallo, 1996). This basis immediately moves this project into an area quite different from most other projects utilizing technology in education. Rather than only using computational objects to help people perform a given curriculum better or faster, or to teach technology as a goal in and of itself, technological knowledge and fluency is useful as a facilitator and means of access to broad areas of learning and doing.

Just as textual literacy opens previously inaccessible worlds of knowledge, so too can technological fluency open further worlds via expressing and collaborating in shareable, computational, dynamic, interactive environments. When writing text, one is free to express oneself as one pleases, in one's own ways, based upon one's own experiences and interests. Through this expression, one comes to understand the world, create a unique identity, and communicate and collaborate with colleagues with whom one's thoughts and expressions resonate. Programmable environments like MicroWorlds Logo provide a new means of expression - construction and communication - and demonstrate how computational technology need not be limited to changing parameters in predetermined programs or merely surfing for information. In a world where what one needs to know changes ever more rapidly, developing the ability to learn to learn and apply this learning in constantly developing domains is all the more critical. This then is the underlying basis for Project Lighthouse.

Another unique feature in Project Lighthouse is using an *Immersion Learning* environment as a basis for facilitating broad and deep development of technological fluency. The term “Immersion Learning” is borrowed from the context of learning a foreign language, where “immersion” means a more or less close approximation to “living in the language” as one might do by living in the country where it is spoken. Participants in the projects live in a culture of technology where there is a deep knowledge about, familiarity with, and passion about building and applying technology towards accomplishment of personal, group, or social goals.

The other major aspect to this endeavor is *project-based learning*. While this term is in vogue in educational circles, we practice this somewhat differently than most. Rather than having pre-defined projects, designed to last a limited amount of time, with the aim of delivering a pre-determined bit of knowledge in a pre-determined way, projects within Lighthouse are student initiated and can run for as long as there are good ideas to pursue. Examples to date include:

- a fifteen year old Buddhist monk using MicroWorlds Logo and a digital camera to trace the history of Buddhist artifacts in nearby temples to learn about the history of Buddhism in his region, which he then placed on the Web using the MicroWorlds plug-in;
- a multimedia study of traditional herbal medicine; using voice input, digital cameras and MicroWorlds Logo to create a constructionist language learning environment;
- a program to create new variations on traditional fabric patterns from a northern hill tribe,
- a set of environmental projects designed in MicroWorlds, extended into actual practice to help the ecology of the region,
- designing actual projects to manage water resources and to provide expertise on crops to improve the agriculture and ecology of a poor region with a harsh climate.

Since two major goals within the project were to work with people of widely varying ages and to have all of them develop technological fluency by constructing many projects, we used Logo as the primary language with which to develop fluency. In this way, everyone would share a similar basis from which to grow. In our early use of the Internet, as people were placing projects on the web we encouraged them to use whatever software they desired. For the most part people used the MicroWorlds plug-in for Netscape, as they were the most familiar with that. In addition to MicroWorlds Logo, we had office automation software, and applications for graphics, photos, and multimedia. We found that as people developed fluency first, moving from one software package to another was not so difficult. Beginning with Logo, and developing real projects, provided a basis from which going to a variety of other applications was more straightforward and successful. In past projects we had found that it was typically difficult for learners to begin with specific product applications and then be able to leverage from that into other packages.

PROJECT LIGHTHOUSE BACKGROUND

Although there was strong agreement on the need for the project and the rationale behind it, there was tremendous trepidation regarding its ambitious design. Almost every Thai commentator believed our effort would be futile if we worked with the existing teaching corps, and if we did not begin with only new students not yet affected by existing schools. There were strong reservations about the passive nature of Thai students, about the poor quality of Thai teachers, particularly in poor and rural areas, about the capability for changing the methods of teaching. People did not believe that Thai students would take to an open-learning situation since they were so accustomed to being passive learners. Teachers were accustomed to lecturing without question or discussion, and then testing rote knowledge. Although people desired change, they were worried that it would not be possible without years

of re-training, or perhaps a totally new teaching force. How could teachers who had little education themselves, and no experience in learner-centered classrooms, possibly perform to the extent required in such a different, technologically rich setting? Indeed, many wondered whether the teachers could learn the technology at all, let alone use it for teaching and learning.

However, less than one year's work has dispelled the basis for these doubts. Thai teachers and Thai students have already accomplished tremendous things. Although we have just begun and aim to do much more, already we can view this project as a major success.

To help the teachers develop, as well as to learn about the situations in order to have a better feel for the activities and organization, we planned for three sets of two-week preparatory workshops, for six weeks in all. In the interim periods between workshops, the teachers were to build projects in MicroWorlds Logo themselves, and ask questions from the workshop facilitators via email or fax. Discussions and readings would continue throughout.

The requirement of six weeks as a minimum length for workshops was based on our experience with two projects grounded in the same philosophy although enacted in a very different situation. In the summer of 1995 I led a six-week program for low-income youth in rural Maine in the United States (Cavallo, 1996). The project ran from 9:00 until 5:00 five days per week for six weeks. None of the youth had any prior computer experience. None of the youth had done well in school. Indeed, some had already flunked out or dropped out. Yet, by working in an immersion environment, beginning by developing technological fluency first using MicroWorlds Logo, then adding LEGO/Logo, and ultimately StarLogo, almost without exception the youth accomplished tremendous amounts.

Most importantly, they developed vastly different and improved attitudes towards themselves as learners and as intelligent people. They also fundamentally changed their relationships with each other and with their communities.

Based upon the success of the summer program, the host organization, the Training and Development Corporation (TDC) bid for and received the charter to operate a brand new Job Corps Center at the site of the former Loring Air Force Base in the far north or rural Maine. TDC received the award in the late summer of 1996 and began operating the Loring Job Corps Center of Innovation (LJCCI) in January 1997. The LJCCI was an attempt by TDC to utilize a technologically rich environment, and the ideas of Constructionism, technological fluency, immersion learning, and project-based and enterprise-based learning to provide a dramatic improvement in vocational education.

However, although the LJCCI was ostensibly freed to experiment and go beyond typical Job Corps requirements except those dealing with safety and assessment, many in the management of the Center still clung to the traditional culture and would not make the changes to which they had committed. This meant that teachers only received at most two weeks of workshops, with the majority only about six days. The result was that people learned to use MicroWorlds Logo somewhat, and LEGO/Logo very little, but did not have the opportunity to re-think how the technology could be used in a non-traditional school-like way.

The technology is one important part of the overall plan, but knowing the syntax of a computer language is not the goal of the workshops. The real goal is to re-think how we approach learning, and to begin to practice how we can use technology to create more learner-centered environments. Thus, the staff at Loring did not have the time to develop their thinking or gain enough experience, and although there were many individual successes, the overall hopes have not yet been realized. As two weeks of

workshops was insufficient to overcome the “grammar” of school, we decided that six weeks of workshops were the minimum required in Project Lighthouse.

The first workshops were in the Chiang Rai Non-Formal Education (NFE) center. Three separate departments divide administration for education in Thailand. The Bangkok Municipal Authority has responsibility for Bangkok. Formal Education within the National Education Ministry operates the traditional schools. The Non-Formal Education department of the Education Ministry in Thailand serves several functions. Compulsory schooling Thailand only recently was increased from four years to nine (and this year may be increased to twelve). Many people only attended for four years and then left formal schooling for various reasons, primarily economic. When people with little formal schooling wish to return to take courses, or to study to take the sixth, ninth or twelfth grade school examinations for certificates, they study through NFE. NFE also provides vocational education, teaching traditional trades, and makes education available in rural and remote areas where there is no formal school.

Project Lighthouse decided to work within Non-Formal Education as one of the original four pilot programs for a variety of reasons. First, there were quite a large number of NFE administrators, staff, and site directors who believed in Seymour Papert’s approach.² They actively worked to create pilot projects within NFE that would run independently and be free to attempt radical changes and potentially demonstrate deep learning results. Non-Formal Education already had a tradition of somewhat student-centered work: classes were discretionary and the work was typically self-paced. In many villages, it was already the case that when people decided to learn

2 These people included the Director General at the time, Dr. Kasama, through her staff such as Dr. Sombat, Sr. Snong, and many others, and NFE staff and site directors in the regions like Dr. Suchin, Ajan Ackachai, and Ajan Jirachai.

something, they would only then form a group to study it within NFE. The population served by NFE is typically from the lower socioeconomic strata. Finally, in the past NFE was viewed as not providing very high quality education. Thus, improvements in this sector would be of great benefit to Thai society.

The teachers spent eight hours per day in the workshops, five days per week for two weeks at a time. While this is not unusual for a workshop, the idea was that they would extend this access to their students not merely for two weeks, but for the entire time they would spend in Project Lighthouse (potentially years). With one computer per student and the computers available at all times, this was a true immersion environment. People could use technology as an expressive tool, as ubiquitous but more powerful than a pencil. They could use the computer not only as a thing in itself but as a tool in a wide variety of activities. The students, if they chose, could not only do math and science with the computers, but also history, art, music, video, writing, reading, and whatever else they desired.

At first the teachers were somewhat disconcerted with having no exact instructions to follow as a recipe. They clearly were unaccustomed to open-ended assignments in school settings. However, as one by one the teachers began working, they watched each other, incorporated what they liked into their own projects, and the initial reticence quickly faded.

We still worked with an English language version of MicroWorlds in the first workshops. As most of the teachers had studied some English, this worked out adequately³. Even though people were working from the English language version they all wanted to make projects of a more

3 However, LCSi developed a Thai language version, with input from Thai MIT students and other Thais participating in project Lighthouse. Later workshops were given with the Thai version of MicroWorlds.

Thai look and feel. One made a little travelogue of Thailand, where you could visit historical sites as you drove your turtle around a map of the country imported into the project.

We began the workshops doing some turtle geometry in order to become familiar with the language and commands. We also introduced making simple animated stories. Of the twenty teachers attending the workshop, only two had prior computer experience beyond using a word processor, and those two primarily understood computer setup and repair, not programming. However, everyone quickly joined in and created projects. Although each one created projects, they often worked in groups, taking turns leading and helping each other. In this way knowledge quickly spread through the entire group of participants. The first set of worries that Thai teachers would be incapable and unwilling to work with computers quickly was set aside.

Several of the teachers still were responsible for classes during the day and thus missed part of the workshop. One with teaching responsibilities made little progress the first two days. However, on the third day, his project was far advanced and many of the others were asking him for help. When I inquired what had happened, the others told me that he was returning after dinner and staying until two or three in the morning working on his project. This effort had so inspired the others that all of them were now staying through the night. Thus, this dispelled concerns about teacher capability and motivation.

During the workshops, we introduced more programming concepts, always in the context of examples and projects that might be of interest. Typically, we ran these mini-sessions either after observing people's work and seeing general misconceptions or to introduce new ideas that would help people accomplish something important within their projects.

Having the topics emerge from the work of the students was critical to concretely grounding the programming ideas in the context of their work and needs. As they worked on projects of their own choosing, the workshop facilitators would go around the room, observing their work, asking questions, or responding to the questions of the participants. At various intervals, the participants would demonstrate their projects and talk about their ideas. This helped spread their ideas through the whole group. We also held many discussions about learning, teaching, and school. These discussions often focused on powerful personal learning experiences and how they most often occurred outside of school. We contrasted the nature of the personal experiences with the organization of school. We then explored whether these differences needed to exist.

One striking point emerged in every case: even though all of these teachers went to an education college, *they had never discussed learning, only teaching*. The focus was on material and how to convey information about it. While no doubt this is important, it is odd that the learner is left out of the picture. Especially now with the focus on learning to learn, bringing the learner back into the equation is more critical than ever. The teachers all expressed relief and joy about this common sense revelation and all began using introspection about their own experiences as learners as a guide for what they would want to do with their students.

The effort in the northeast of the country, in the area around BuriRam, highlights the difference in Project Lighthouse from the typical conception of school. Before beginning work in the area, Papert and Marina Umaschi Bers, a researcher in Papert's group at the MIT Media Lab, engaged the residents from each village in a discussion about if they wanted computers, if so why, and finally, if they had them, what would they do with them.

One of the most striking experiences was in a village where the village leader replied that they wanted to gain more control over their lives, and they believed that certain uses of the technology could help them. They told of how a brown fungus had developed on their rice, and they did not know the cause or the remedy. They also recounted how the cattle had developed a swelling on their hips. These factors led them to believe that somehow their water supply had become contaminated, perhaps by chemicals previously placed into the soil. They did not know how to deal with these problems. They were reluctant to call the local authorities for a variety of reasons. Primarily, they felt that every time they had called them in the past, the outside experts would come in to the area, make some determination not only without consulting the local villagers but also without even bothering to explain how they came to their diagnosis. The experts merely gave some new chemical, or gave the cattle some inoculation, and left without helping the villagers to understand the problem or what to do about it. They were suspicious that this was the cause of the contamination. They wanted to end this cycle of dependency and lack of control by gaining access to information and gaining control of the situation. They viewed competency with the technology as a plausible path to this control.

Later Savalai Vaikakul, an MIT Thai student in Papert's group, Alice Cavallo, and the author led a technological fluency immersion workshop in BuriRam. The workshop was attended by the sixteen people from surrounding villages⁴. The village leader who had described the agricultural problems attended, as did several other elders,

4 The workshop also included a few teachers from the area Non-Formal Education center, a few people from the local teachers' college, two professors from Kon Kaen University, and several people from the Population Development Agency (PDA), a non-governmental organization active in the region at whose center we held the workshop.

accompanied by teenagers from their villages. Our goal was to have at least two people from each nearby village.

We began the workshop showing how to turn on and operate a computer. We did not want to spend much time with preliminaries thereby delaying the moment when people could begin to perform meaningful work. We knew from discussions that many in this workshop had left school after only a few years because they did not feel it added anything to their lives. We did not want to lose them as well by taking days to show arcane aspects like file directories and DOS commands

In this way, beginning with MicroWorlds programming was essential to quickly producing something real and satisfying so that interest was maintained. Creating animations, or pretty designs with turtle geometry, was sufficiently captivating to enable people to begin and continue to work. The fact that it, to at least some degree, is personally expressive helped, as each one could make something of their own choosing, reflecting their own aesthetics. We did not have everyone follow our examples, although the pervasiveness of following instructions was something we had to continually contend with. When we gave examples it was not meant to be taken as, "Everyone do exactly this." However, this is what people were accustomed to.

People did manage to learn enough about working with personal computers to function properly. They also managed to build their own programs during the first day. There was considerable joy and satisfaction among the participants over having created their own projects, primarily aesthetically pleasing designs from geometric commands and the use of colors. Especially salient was the feeling of mastery over a high technology device, the computer. This was particularly empowering and liberating since many aspects of school and modern life left many of these people feeling powerless and alienated. They had a feeling of accomplishment that they could program and

control this device. With this spirit they moved on to attempting to use the technology under their control for projects to their benefit. Moreover, accomplishing this quickly, without months of prerequisites, was critical so that they were not further alienated.

BuriRam

The development of work in BuriRam took two interesting paths, highlighting some of the major objectives within Project Lighthouse. Both paths depend upon developing technological fluency in order to use the technology as an expressive tool to address problems of particular interest to the individual people and their communities. One path was to learn to address the agricultural problems. The other was to assist people in operating their local factories to help make them more efficient and effective. Both efforts highlight releasing learning from the boundaries of something children do while isolated in school during school hours with little real life relevance, to something that is deeply embedded in the life and interests of the children and their neighbors, and can be applied to real social issues.

Imposing a preconceived program from without, no matter how well intentioned, suffers from many problems. Not the least of the problems is that it places the people in the position of objects on which to act rather than as active agents who do act. It is this use of power that underlies many problems in traditional school (Bourdieu & Passeron 1977, Bowles & Gintis, 1976). Traditional school does not merely transmit information about subject areas: it also plays a socialization role. People develop opinions of themselves, their intelligence, their self-worth, their relationships with others, both peers and elders. They develop connections to or alienation from each other and their communities. They develop their roles and make determinations on their places in their societies. Naturally, life in school is but one part of these

determinations as much of life occurs outside of school. But the socialization role of school, although potentially positive, also can be detrimental when robbed of relevance, or when people are placed into passive and submissive roles without the possibility of participating in determining the activities they will do and what roles they can have within these opportunities.

In this area we collaborated closely with the Population Development Agency (PDA). PDA is a non-governmental organization developed by Khun Meechai Viravaidya of Thailand first to combat over-population, which in the seventies was a major problem for the health and well-being of Thailand. After successfully addressing that problem, PDA turned its attention to matters of sustainable rural development, including changing farming methods to be environmentally friendly and supporting clean industrial development in rural areas⁵.

Before any introduction of technology, we engaged the residents in discussions about what they felt were the key issues in their lives, and what they felt they needed to address. Almost every idea revolved around issues in access to clean water, and its use in household and agriculture. BuriRam is described as having two harsh seasons, flood and drought. Either there is too much or there is no water. This results in many villagers only being able to grow one rice crop per year, barely enough to provide a meager living for the year, not enough during the bad years. In our discussions they quickly realized that having access to water to grow an extra vegetable crop could double their yearly income.

⁵ During the economic boom in Thailand, life in rural areas remained difficult. Thus many people left the villages to seek work in urban areas, primarily Bangkok. This had dual deleterious effects of over-populating the urban areas and devastating the rural areas. PDA tried to support development of clean industry in the rural areas to make them more economically viable, and to help keep the rural families intact, as opposed to where the adult wage-earners would leave the villages to go to the cities, leaving only children and the elderly.

The villagers and the participants from Project Lighthouse began devising ways to collect and maintain fresh water. We designed ways to create reservoirs in order to maintain the water to irrigate their fields. We designed dams to harness the floodwaters and connect to pumping systems for irrigation. We also re-designed agricultural field layouts to take advantage of the topography of the terrain to better support multiple plantings of a variety of crops. Lastly, we began developing decision support systems to guide diagnosis and treatment of problems with pests and fungi in the cultivation of rice. As in other Logo projects, the goal of the decision support systems was not so much for the benefit of the others, but to help the developers themselves formalize and strengthen the knowledge required.

The villagers used MicroWorlds Logo to map out, plan, and design their potential solutions to the various problems. The graphics capabilities of the software facilitated the visualization of the situation and remedies. Making this concrete and manipulable was critical towards successful comprehension. We even used digital cameras to photograph the areas, which we then imported into the MicroWorlds projects in order to improve accuracy. A true benefit of using computational technology as opposed to other media was enabling the proposed solutions to be shareable, dynamic, contextual, interactive, and easily alterable. Perhaps most important was that the solutions were a powerful expression of their own ideas.

There is much mathematical knowledge required to determine such problems as the amount of water needed to grow for a certain area of particular types of crops; how deep a reservoir would be needed to hold that water given particular rates of evaporation and drainage; the amount to pay for the work and how much benefit they might receive in return. The ideas of drawing maps, drawing to scale, and using Cartesian coordinates were foreign, even if they had been covered in school. The vast majority of

those working on the projects had left school after only four years. The children who joined us likewise had either quit or were totally alienated by their school experience. The math they had learned in school was not a useful tool. However, everyone quickly mastered the underlying mathematics in the context of the problems they had chosen.

More important than the gaining of mathematical and scientific knowledge, was the change in attitude from passive resignation to active engagement. In the beginning of the project, many people stated that they did not know the math needed, that they were not capable of attempting such important and complicated work as constructing dams, that they could not even attempt to address these issues. As they gained competence with the technology, they gained confidence in themselves. We firmly believe that this confidence, along with their newfound tools of technological, mathematical, and scientific fluency, will serve them best in the long run.

There had been previous attempts at building dams but each time the effort had failed. It had been initiated from outside the community, performed by outsiders, and not only had not worked but more importantly had contributed to sapping the residents of their self-esteem and community control. Active collaboration among the residents was one of the essential lessons learned when the World Bank sponsored the introduction of water pumps into rural areas. The rationale behind their introduction was that the water pumps would not only help health matters, but would also leverage many other gains as people would spend less effort walking, carrying and hand drawing water. This would free them for other more productive activities. However, even though everyone needs and appreciates having clean water, the water pump project did not go smoothly, actually failing in a relatively large proportion of areas. At some sites people refused to change routines to use the pumps, often because they

were poorly located. At other sites they fell into permanent disrepair. At other sites they were simply vandalized and cannibalized for parts.

The primary factor for successful implementation of the water pump project was the early participation of the local residents in the full-range of decision-making about the project. Although the technology itself was the enabler, agency, ownership, local factors, and full partnership and participation counted for more than the technology itself, even with a relatively simple technology like water pumps. If these are critical success factors for simple technology, they could only be more so for more complex technology like computers and telecommunications.

The strong influence of Paulo Freire in this work is quite evident. In Freire's early work with rural Brazilians in the northeast part (and poorest) part of the country, he and his colleagues had tremendous success developing textual literacy among the people where previous school-based attempts had virtually failed. He too engaged the participants in discussions about what were the most critical issues for them before engaging in any teaching or learning activity. Once the critical issues were identified, connections were made through these issues to many bodies of knowledge.

Freire was one of the earliest critics of a "banking" approach to knowledge, that is, that knowledge is acquired and stored away in little boxes to be retrieved when wanted, and that the role of school is to transmit those pieces of knowledge for storage (Freire, 1972). However, although much more humane than traditional school, many educators who have adopted some of Freire's ideas still remain embedded in the grammar of school. Thus, Freire's approach becomes something to be used to teach preconceived formulations of knowledge in traditional subject areas and curriculum.

Our approach in rural Thailand returns to the origins of Freire's work. We leave the idea of preconceived subject

areas and curriculum and using the critical issues as a pathway to teaching them. Rather, we hope to develop multiple fluencies, such as technological and textual, and continually apply them to the issues of communal and personal importance. The communal process of analyzing the situation, conceiving activities, designing them, enacting them, reflecting upon them, determining what was of value and what was not, debugging them, and beginning the process anew, not only helped elevate the populace from a passive position but also provided important practice in critical thinking. This too is what is required in the modern economy. That rural villagers, previously left out of the modern economy, could begin to successfully practice this in an extremely short period of time is a critical result.

Indeed, Freire's original work and ours show that the villagers' previous lack of educational results is not due to any lack of intelligence. On the contrary, it is due to the methodology imposed. Once freed to use the familiar as a mobilizing force to understand and work on the important, people can learn and accomplish a tremendous amount in an incredibly short period. The true value of this type of work is not just that people learn to read, or to do math, or any subject, although of course these are all critically important. Rather it is the change in their relationship with the environment. They are no longer viewed, or view themselves, as unintelligent, passive, or victims. They develop to be thoughtful actors. The empowerment within this framework is dependent upon but ultimately more important than any particular learning of a school subject.

In BuriRam, in addition to the work in villages, a second track was designed to assist the Population Development Agency (PDA) in their efforts towards developing environmentally clean, sustainable economic development efforts. PDA primarily set up a number of shoe factories, assembling shoes for Italian makers. As the standards of these shoe companies were quite high, and the education

level of the villagers quite low, there were problems both with efficiency and quality. The villagers did not know statistical quality control methods. Nor were they accustomed to systems thinking, debugging, or other tools of modern industry. Thus, quality problems were high, throughput was low, and the hierarchy was higher, thereby reducing profitability for the village cooperatives.

To attempt to address this, once the villagers had become somewhat fluent with MicroWorlds programming, we introduced working with LEGO/Logo. With both LEGO/Logo and MicroWorlds Logo, the villagers working in the shoe factories began to model the operation of the factory, looking for ways to make the processes more efficient. They could model the processes with Logo, and build LEGO models of alternative factory layouts. They also gained a greater awareness of the system as a whole, rather than focusing on just their individual local role. While it is still early to look for results, the cooperative management is very optimistic about the benefits. This is similar to the experience of Jose Valente and his colleagues, who also have performed such work in Brazil.⁶

At a meta-level, the process of learning and doing in these examples is very powerful, and a key within Freire's work as well as ours. The process of analyzing what are the critical issues in their own lives, doing projects to produce positive impact on these issues, reflecting upon the actions and results, and beginning the cycle anew provides practical experience in critical thinking. It also places the participants as the active agents in their world, rather than passive receivers of the actions of others, applying this critical thinking in whatever other aspect of life they choose. They also become adept at transferring their experience of approaching and dealing with problems to other areas of interest. They are building case experience and thinking about how things apply and in which ways.

⁶ Personal communication

CHIANG RAI YOUTH HOSTEL

One other effort within Project Lighthouse bears mentioning. Project Lighthouse initially contained four pilot areas. They were to create a new kind of learning place within Non-Formal Education (NFE) in urban centers, to address the village situation, to help provide teacher and staff development to school systems and Non-Governmental Organizations, and to address educational and social issues surrounding at-risk children.

In Thailand, prostitution and child prostitution in particular has been a major problem. Many efforts are made, some with the noble assistance from Non-Formal Education, to both try to prevent children from entering prostitution or to help rehabilitate them upon leaving. A major drive within this is to provide education and retraining to children and young adults so that they have other viable options. Many times these children are from rural villages and have had only a rudimentary education. They have very few other prospects for earning a livelihood. Many are orphans, or are from villagers that have a history of selling children into prostitution, or are attempting to find other alternatives after spending some time as prostitutes.

Until now, the job training offered these children was quite rudimentary. This included skills like sewing, crafts-making, and other low-wage, manual labor skills. The first group that began working with Project Lighthouse was comprised of twenty teenage girls living in a hostel in Chiang Rai. They already were attending the NFE Center there that was participating in Lighthouse but were all working towards their sixth grade certificate, even though some were as old as eighteen. However, prior to Lighthouse their education was traditional and their vocational training was simple.

Not surprisingly, this did not provide much disincentive to prostitution. Moreover, working with these girls

presented many other problems. For the most part, Thai was not their native language as the girls came predominantly from hill tribes with their own languages, customs, and history. There was little incentive for the girls to learn much of what is in the standard curriculum. The teachers encountered many problems familiar to most teachers. The students did not see much benefit in learning history, or science, or even to learn to read. Thus, they did not expend much energy. In addition, since the class sizes were quite large, it was logistically extremely difficult for the teachers to provide enough individual attention to help motivate and communicate with the students.

When this group of girls joined Project Lighthouse, they began with immersion work on building technological fluency. After a few months of work within Project Lighthouse, we arranged a special workshop led by MIT Media Laboratory Professor Gloriana Davenport and assisted by her students Philip Tiongson and Arjan Schutt. The outward purpose of this workshop was to do multimedia projects in electronic photojournalism. The students would use digital cameras to collect photographs that they would load on-line, and then write narratives to tell their stories. They would load this onto the Web for all to see.⁷

In order to become accustomed to the technology, they experimented with the cameras, taking pictures of each other, and writing their autobiographies. While doing this, they discussed technical aspects of photography including aspects of lighting, composition, and how images were created, both digitally and with film.

After gaining some fluency with the technology and the ideas behind creating narratives, they divided into five groups of four for a major project. Coincidentally, the

⁷ This site undergoes frequent revisions. The primary MIT-based site for the project is at <http://el.www.media.mit.edu/projects/lighthouse>. There are several Thai-based sites connected to this project. Links to those can be found from the above mentioned Lighthouse site.

young women were practicing a dance performance that they were to give in an AIDS village nearby. Professor Davenport used this as a reason to link the efforts. The girls agreed to do their big project around the life stories from the people in the AIDS village. This became a unifying theme for much of their learning. They not only wrote very compelling stories about these people and their feelings and reactions, but they also learned about health, biology, and sociology. Thus, this type of project embodied the spirit of Project Lighthouse. They used real, compelling issues in their lives as a basis for constructing projects, acting, and learning. The world was not carved up into pre-determined chunks for them, but was treated as an integral whole, where the values in the traditional subject areas of language, math, science, and social studies, emerged for them in meaningful, authentic ways.

This multi-faceted project had many beneficial aspects. While previously the young women did not write much or very well, by telling their own stories they were motivated to write, and write well. That the stories would be published for anyone in the world to see was an added incentive.

MAE FAH LUANG

Mae Fah Luang is rural area in the north of Thailand, tucked against the Burmese border. The residents are from various hill tribes. Mae Fah Luang received electricity only three years ago. This year brings the first paved road to the area. The first formal school was initiated two years ago. Naturally, Mae Fah Luang suffered from the typical problems of rural areas; scant resources; poorly trained teachers; no libraries; difficult access to information; and a very poor economy. Under the direction of Ajan Jirachai, the head for Non-Formal Education in that region, Project Lighthouse aimed to change the learning environment and to have a positive effect on life in the area.

The NFE center adopted project-based learning readily. Here they decided to focus on environmental projects. Slash and burn farming had been a way of life in this area, but it had wreaked havoc on the environment. The NFE staff wanted to investigate how they could perform more ecologically sound but still productive farming. Students investigated their ideas within MicroWorlds projects. Afterwards, they tried their ideas. The group built a dam on one of the rivers. In a short time the dam broke. The group returned to MicroWorlds to model the river, its flows, the dam and its structure, in order to conceive a better design. They are now implementing their improved version. Here, as in BuriRam, they also will begin to create decision support systems in MicroWorlds to assist the farming. The idea is not that the decision support systems will provide all the answers. Rather, the constructionist practice of building the system will help broaden and deepen the knowledge among themselves.

When Project Lighthouse first began work in Mae Fah Luang, the computers were installed in the existing, rudimentary NFE center. The satellite control was placed outside. Not surprisingly, before long the harsh elements and the wildlife combined to damage the equipment. Khun Paron, the former CEO of Siam Cement, arranged for Siam Cement to donate the materials to construct a building to house the project and its equipment. The villagers themselves, including the children, all volunteered to construct the new computer center building. Everyone pitches in to maintain and clean the building. As is the case in every Project Lighthouse center, even though the area is quite poor, no equipment has been stolen, damaged or abused. We believe that since the Lighthouse activities emanate from and serve the people of the area, they, in turn, treat the equipment as communal assets.

VACHIRAVUDH COLLEGE

Vachiravudh College (VC) is the first Lighthouse pilot site in Bangkok. It is an elite private boarding school for boys ages eight through eighteen. While once the pinnacle of Thai education, its board felt that it was no longer providing a high quality of education adequate for the times. They felt it had become mired in ways of the past.

A new director, Dr. Chai-Anan, was hired and he began reforming the school, changing the style of the school to a learner-centered one. Dr. Chai-Anan and his staff met with Papert and his team, and found they agreed on many things. The college joined Project Lighthouse and began incorporating technology, particularly Logo and LEGO/Logo, into their new learning environment. They adopted a constructionist, project-based approach across the entire school. VC also hosts workshops for all of Project Lighthouse in its computer center. The workshops are attended by not only people from existing sites, but also by representatives from the Bangkok Municipal Authority, which directs education for all of Bangkok, other school administrators, teachers, and various Non-Governmental Organizations.

What is particularly interesting about the inclusion of this site is that the same philosophy and practice that governs the actions in the most remote and impoverished areas is the same practiced for those from the highest stratum of society. We hold the highest expectations for each learner and participant and provide all of them with the best possible support and materials. Projects may differ based upon interests and environments but the underlying organization, tools, and basis is the same.

This similarity has given rise to new opportunities for all participants. Students from Vachiravudh have traveled to the remote hill tribe villages to assist in various Lighthouse projects. This type of collaboration is rather unique but has been highly satisfying to all involved.

Likewise, many teachers and students have come to assist and to learn at Vachiravudh. In an educational world that often tracks students and diminishes shared experiences across society, and provides different learning resources and opportunities, this aspect of Lighthouse has begun to show the possibilities from a more equitable approach.

UNIVERSITY LIGHTHOUSE LABS

Another unplanned but very positive development is the creation of *Lighthouse Labs* at various universities. As of now, the participating universities include Kasetsart, Chiangmai, KMUTT, Khon Kaen, and Suraraneerajit universities, and at Rachaphat BuriRam College. After several Thai members of Project Lighthouse visited the MIT Media Lab and saw the work of Papert's group, they felt that creating such groups at the universities in Thailand would not only provide good support for the project, but would also strengthen university education within Thailand. In this way, a constructionist approach is entering the university labs. The students from the labs provide technical support to the sites, as well as helping Lighthouse students direct projects. The university Lighthouse labs also are beginning to work on the development of new technology for learning in the way that the Epistemology and Learning group at the Media Lab does.

INTERNET USE

Access to the Internet of course is critical. The World Wide Web enables the villagers to gain access to information and people otherwise virtually impossible to reach. The importance of this, particularly in rural and impoverished areas, is paramount. The cost of text libraries was prohibitive. Access to a wide range of experts in remote areas is difficult if not hopeless. The Web potentially, and

relatively inexpensively, connects previously remote areas.⁸

Use of the Web within Project Lighthouse is not just for information retrieval, but also is a means of communications with outside experts and colleagues, and another place for constructionist activities. While essentially everyone proclaims that the Internet will change education, almost all of the early proposals for its use are no different than looking up textual information. While this is a fundamental change in remote areas mentioned above, in many cases this is no change at all, and perhaps even a change for the worse.

Thus, in addition to information access, the Web is used as:

- a publishing medium (as in the community magazine of Mae Fah Luang),
- a site for multimedia presentations (as in the Buddhism work in Lampang or the AIDS village reporting in Chiang Rai),
- an information dissemination space (as in the decision support systems in BuriRam),
- a collaboration space (among the sites in Thailand and between the Thais and the MIT team or with both the above groups and outside experts elsewhere in the world).

8 When Mike Best was working on the community magazine project in rural Mae Fah Luang, he and I remained in electronic contact daily. As he was preparing to leave to spend a few days in Bangkok for meetings, Mike wrote that I had better send anything important to him quickly before he left Mae Fah Luang, because contact from Bangkok was slow and often unreliable. In Mae Fah Luang our connection was quick and dependable as we used 2-way satellite via Shinawatra Satellite, donated to the project by the ThaiComm Foundation. Shinawatra was a primary sponsor of Project Lighthouse, and the project gained tremendously through the support and wisdom of its president, Dr. Dumrong and its founder and owner, Dr. Thaksin Shinawatra.

The allure of publishing on the Web for anyone in the world to access adds incentive for students. The practical nature of many of the Lighthouse projects provides tremendous community benefit through using the Web. Here again, the technological fluency gained via the Project Lighthouse approach is rewarding as maintaining a Web server and placing multimedia pages onto the site requires the project-based technological expertise developed within Lighthouse.

NEXT STEPS

Since Project Lighthouse is off to a very encouraging start, people have begun to expand the project by adding new pilot sites, and by incorporating ideas from Lighthouse into other similar sites. Thus, in the north, people in Non-Formal Education are working to add similar pilots through other NFE centers. They too will begin with immersion workshops developing technological fluency, working initially with several small groups of about twenty students totaling around eighty per site. Two private schools in Chiangmai will begin adapting ideas of constructionism, technological fluency, and project-based learning. They will try to benefit from the work in the north, as well as the example from Vachiravudh College.

Besides developing the Lighthouse labs, in the next few months we will attempt to strengthen the activities at each pilot site. As a group, we are collecting interesting learning stories, not only to help document the project but also to use as a way to reflect upon the activities with the intention of strengthening them and deepening our understanding. We will add new pilot sites and will spread activities into existing learning centers. More teachers, administrators, parents, and children will attend workshops, demonstrations, and assist in projects. They will incorporate what they like into their sites, and, we hope, will devise new activities that will be folded back into Lighthouse.

We are just beginning new projects. In BuriRam we hope to build decision support systems in MicroWorlds, not so much for the benefit of others but more so for the benefits gained by constructing them. The decision support systems will assist with determining safe uses and collection of water, and guiding sustainable, organic agriculture. We expect that the process of building such systems will help gather and distribute the systematic and scientific expertise as well as build and disseminate important knowledge about these matters. In the north, people will begin to develop tele-medecine projects to aid in providing health information to villagers who live far from clinics. In Mae Fah Luang⁹, people have created a Web-based community magazine, and will begin more traditional crafts design. They hope to use electronic commerce not only to provide income but also to help fund Lighthouse in their area. As more people are free to imagine what they can do and what they can learn, more and more projects will come on-line.

CONCLUSION

Although it is still very early, only nine months after the beginning of the initial workshops, Project Lighthouse has already shown many extremely positive results. If we take as its primary goal bringing into question how we choose to educate our children, in other words providing concrete examples of powerful learning that does not fit the existing pattern, then already it is a resounding success. Project Lighthouse has generated such tremendous enthusiasm that one of the biggest problems we face is not growing too fast. Despite the severe economic crisis, companies are still funding the project, believing their future depends upon this and other such efforts.

⁹ Marina Umaschi Bers, Michael Best, and Savalai Vaikakul coordinate the work in this site.

The idea of Constructionism resonated deeply and quickly. The idea of building deep understanding of domains through the construction of artifacts struck a strong chord. The process of creating an outer expression of an idea about something, using it as a concrete basis for reflection, going back outside oneself to refine the object, and so on, quickly took hold in each site. Khun Paron, a board member of the Suksapattana Foundation that coordinated Project Lighthouse in Thailand, used the idea of Constructionism to help convince many people and organizations to join and support the project.

The idea of technological fluency also is critical. At the beginning of the project, most people viewed the use of computers as a subject in itself, in the way that the idea of computer literacy is usually meant. That is, people advocated teaching children the components of the computer, how to use it in a rudimentary way, at most teaching a few software packages. This was what was typically done in schools and in Non-Formal Education centers.

However, people have come to embrace the view expressed within Lighthouse. People are using technology as an expressive tool, as ubiquitous but more powerful than a pencil. Using MicroWorlds Logo was an important first step in this process. Constructing personally meaningful projects, and thereby gaining fluency with the technology, opened the doors to adopting the same methodology on and off the computer. Using the computer not only as a thing in itself but also as a means of exploring, learning about, and doing projects in other areas of interest is deeply integrated into the lives of the participants. This includes all manner of computational devices, and not just the one that sits on a desk.

Project-based learning has also taken hold. This has come not to mean pre-determined projects, but projects proposed and initiated by the participants themselves. Teachers are adapting from having a pre-determined lesson plan to following the lead of the students, or

sometimes initiating projects themselves, and subsequently making connections to formalisms and bodies of knowledge based upon the situation and the state and experience of the learners.

Another very positive effect of Project Lighthouse is the breaking down of barriers artificially placed by traditional school. No longer are kids segregated by age. No longer are kids segregated from their parents or their communities. Their projects are not toys or meaningless exercises. They work on issues of importance to their communities. They still can do playful projects just for fun if they choose. But their work can have real impact and importance, and this not only provides motivation but also helps put the learning of school into practice. Perhaps the biggest change taking place is changing school from the place to get taught to the place to learn.

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