

Technology as a Trojan Horse in School Environments (II)

The emergence of the Learning Atmosphere

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Abstract:

This paper, based on case studies conducted in public schools in Brazil, proposes a framework to model intervention in education systems using technology: the Learning Atmosphere. The motivation is to show that innovative learning with expressive technologies can happen even in economically disadvantaged regions, such as public education systems in Brazil, where our case studies took place. The case studies demonstrate the importance and possibility of a powerful learning experience that builds up from the local culture and expertise, elements often disregarded in schools. Technology plays a central role, enabling diverse and innovative ways of working, expressing and building. In addition, it makes possible epistemological diversity, empowering of students and fulfillment to teachers, reinforcing the community's own livelihood.

1 Introduction

1.1 The emergence of the Learning Atmosphere

Digital technologies are elements that, being introduced in learning environments, add a rich layer of complexity. We do not have, however, a mature set of models or languages to understand and design such environments.

Nature, on the other hand, offers many models to understand complex phenomena. Some of those, especially coming from statistical mechanics and biology, are changing the way we think about problems in other fields of knowledge. One of them seems particularly interesting for its multi-variability, meta-stability and unpredictability: *atmospheres*.

This paper introduces the concept of the **Learning Atmosphere** as a framework to design and understand learning environments in which computational technology is an inherent component, adding layers of complexity that cannot be properly described or studied using available models. Our approach considers several aspects, such as choice of what to build, which tools to use, affective relationship building, power relations, hidden cultures/agendas, as part of an indivisible whole (the *atmosphere*) that constitutes the real scenario in which the learning experience takes place. Although we will, at times, isolate one of the elements to analyze it in

depth, we firmly believe that the inter-relations and interdependencies are key [Papert 1995]. Our method of micro-investigation, based on observations and qualitative analysis in the field, interviews with students and teachers, is an attempt to address details often overlooked towards educational research, but with fundamental consequences in the quality and depth of the work students conduct.

At the macro level, the “Trojan horse as a Trojan horse” metaphor, chosen as the title of this paper, describes the topology of a dilemma: an element whose advantages give perils as well.

Nowadays, schools are very interested and willing to adopt technologies quickly, as computers supposedly get cheaper and easier to use. Our belief has been that we could utilize this demand to introduce new ideas about learning *together* with the technology – the *Trojan Horse* metaphor. However, as our fieldwork demonstrates, introducing new technologies and ideas for learning into a system such as a classroom, school, or school system necessarily has a number of reverse effects, normalizations efforts, and reverberations throughout the system. The aforementioned Trojan Horse becomes itself *another Trojan Horse*: the exact same advantages of the new digital technologies that motivate us to introduce them in education (low-cost, low-threshold, high anticipation), also open the possibility of a very superficial contact with them, that do not develop the necessary fluency to push the transformations in school’s everyday life that we would like to see happen.

We conceived and utilized this framework in a series of nine fieldwork activities, mainly conducted in Brazil in 2001 and 2002, within public and non-profit education systems. This paper will focus on one of them, which took place in São Paulo, Brazil, in August 2001, within a project with the Municipal Secretariat of Education.

1.2 Resistances to change

The discussion about school and its impermeability to change is certainly not new. Many authors ([Singer 1997], [Papert], [Tyack 1995], [Morin 1999], [Kuhn 1962]) have discussed how the school system (and other systems as well) transforms innovative ideas and adapts them to its existing mindset. While Tyack and Cuban, as well as Papert, highlight the historical and developmental aspects, Singer pays more attention to issues of discipline and power, using Durkheim and Foucault as her basis.

In the Brazilian case, although technology has an enormous potential to change existing practices in schools, most of the technology investment focus on large-scale turnkey solutions or standardized training that for the most part ignore the local context. In addition, conflicts between the agendas of the technology providers, schools, state bureaucrats and politicians are extremely hard to accommodate. Other elements also play an important role:

- Public views of what good education should be.
- The choice of technologies.
- The idea of curriculum.
- Culture and power structure of education schools.
- Vested interests of existing institutions and corporations engaged in the business of education.
- Systemic inertia

Pierre Lévy, in *Cyberculture* [Lévy 1999], argues against the simplistic and widely used “impact” metaphor, as if technology was a projectile and the human society a living target. He discusses the use of tools as inherent to human condition:

The techniques would come from another planet, from the world of machines, cold, without any emotion, foreign to all signification and human value. [...] Not only the techniques are imagined, fabricated and reinterpreted during its use by humans, but **also it is the intensive use of tools that constitutes humanity as it is**. [...] As a result, any attribution of a unique meaning for the technique can only be dubious. [Lévy 1999]

We might derive that the *impact* metaphor, as well as the technocentric mindset [Papert 1985], constitute incomplete models to approach the issue of change in education. First, school is not a passive target for technology. Technologies are not extraterrestrial, non-historical artifacts. Research on technologies in education, as a result, cannot ignore the complexity that emerges from the interactions of those two elements in a social context. Not only our solutions, as technology designers, will not fit the local needs, but also we would be wasting the opportunities to interact and benefit from the local culture and expertise, which could be synergetic.

The framework of the **Learning Atmosphere** pushes in those directions. It emerged from the field work activities that we have been conducting mainly in Brazil with elementary and middle school students and teachers. Thus, introducing technology becomes a new kind of Trojan Horse: we intentionally use familiar tools and technologies, with significant changes to make people pay attention, challenge underlying assumptions, and work in new ways. This then becomes a part of the atmosphere and the role of the facilitator is to create a rich, convivial, friendly atmosphere rather than to be a rule-enforcer or conveyor of information. Learning atmosphere is also an idea that brings in an acceptance of complexity and ecology, in which things can be turbulent, and suggests that a homogeneous atmosphere is not the best for learning.

The three major components of our framework follow.

- **Generative Spaces**

The Freirean *generative themes* have been inspiring educators for decades about how to put the learner closer to his social context. We propose the idea of a **Generative Space**, adding multiple possibilities of projects and ideas as a result of the broadening of the tools and media available. The presence of digital technologies within the learning environment adds multiple new entry points and types of activities, changing fundamentally the role of the educator and any theme proposed to the students.

- **Multiple expressive technologies**

One of the important design issues of the experiences described in this work is the simultaneous use of multiple expressive technologies. We choose not to introduce the different technologies separately, in a controlled and planned form, which risks segregating them and building a technology curriculum. Instead, we made the tools immediately available to the participants.

- **Using familiar materials and ways of working**

Part of the building of the **Learning Atmosphere** is fighting the high cost of the technology, especially in the most neglected localities. In most places, before starting the activities, the feeling of both students and teachers was that technology was a strange, costly and non-familiar material to work with.

On the other hand, one of Brazil's strongest cultural traces is the so-called *jeitinho brasileiro* ("the Brazilian way"), a practice of creatively solving problems using what is at hand, finding some way out of difficult situations, instead of waiting for the ideal or formal solution. This implies repurposing and deconstruction of objects and parts as well as customary utilization of recycled and found materials. Participants were invited to bring and disassemble broken and

found equipment and materials, and integrate them into their projects, as well as combining high-tech and low-tech materials, familiar and unfamiliar.

- **Relationship-building**

One of the observations of the fieldwork activities was the fundamental importance of relationship building. Special attention was paid to how trust and friendship developed and played an important role in the learning atmosphere, as well as power issues such as the control over the equipment, playing games during the workshop, browsing the internet and choosing embarrassing themes for projects.

2 Field work

2.1 *Heliópolis*

On our first meeting, the Secretary of Education of São Paulo, Prof. Fernando Almeida, expressed his concern with pilot studies that never go beyond the pilot stage. Almeida challenged us to come up with an idea that could be implemented in the schools of his network, and not only a few. This was a difficult design tension, and a research question: is it possible to come to a formulation flexible enough to be extended over a number of schools while still maintaining its depth?

After all those considerations were carefully discussed, we presented two ideas: Prof. David Cavallo had the idea of having the kids think about the city that they want 10 years in the future, proposing and building solutions using different expressive technologies. I proposed to use “Energy” as a possible theme for one the initial phase of the project, as there was a huge electric energy crisis in Brazil at that time.

Further meetings we had, in March and May 2001, we presented many ideas that were discussed and appreciated. Fernando Almeida suggested a name for the project: **“The City That We Want”**¹. One extremely powerful aspect of the idea was to put together *technology* and the *Freirean principle* of working with themes/ideas that are meaningful to the students and their community.

In August 2001, the MIT and the Secretariat teams decided to conduct the first workshop in the municipal network of schools. The school was located in Heliópolis², the biggest *favela* (shanty-town) in the city of São Paulo, with a group of twenty students, from grades 5th to 8th.

The city of São Paulo constitutes a special setting for projects around innovation in education. During the Seventies and Eighties, alternative, progressive schools flourished in the city, partly in response to the authoritarian educational policy of the military dictatorship that ruled the country. In addition, from 1989 to 1991, the Secretary of Education was Paulo Freire, a symbol of innovative and progressive education. That left traces in the culture of educators in the city, specially in the municipal network.

¹ “A cidade que a gente quer”, in Portuguese

² This work had the contribution of many people, which conducted workshops or helped in other ways. Roseli de Deus Lopes, Alexandra Camargo Alves, Adriana Maricato, Helena Tomoie, Sabo Takahara, Adriana Simizo, Tiago Bernal, Renato Mota Lazaro, Breno Teixeira Santos (University of São Paulo), Alice Cavallo, Arnan Sipitakiat (MIT Media Lab), Paulo Gonçalves, Neide Santana, Lia Paraventi, Tidu, Mônica, Sueli, Ana Maria Moraes de Albuquerque Lima (Municipal Secretariat of Education of São Paulo)

2.2 Energy and the “City that we want” project

I realized in some of my visits to Brazil in 2001 that the electric energy crisis was revealing some of Brazil’s expertise: reutilizing objects in creative ways, improvising solutions, living with few resources, creating solutions for everyday problems, building strong social interaction, hacking³; as well as creating an important awareness towards the meaning of a finite source of energy.

Due to rain shortage and lack of investment, the Brazilian government announced in mid-2001 that the situation was critical and blackouts were bound to happen. Electrical energy, normally considered an endless resource connected to personal comfort and success, became increasingly associated to waste and lack of solidarity.

For our research group, the energy project became a good, concrete, practical first step towards demonstrating our ideas, methodology, and tools, as well as to show the type of results that were possible. I imagined that it would be interesting to have kids model and interfere in the change, designing devices and ways to save energy. However, we also wanted to engage them in a discussion about the causes of the energy crisis, the society of consumption, industrial policy, etc. As Edith Ackerman suggested:

To solve the problem of energy, which was caused by the new technologies, with the new technologies. [Ackermann 2001a]

The Heliópolis school seemed a very interesting and challenging place. The first talk we had with the principal revealed that they had some other projects going on, most of them in the direction of opening the school to the community, together with the UNAS (the Heliópolis Resident’s Association) and its president, João Miranda, a much respected community leader. I asked if he could come for a talk before the workshop, to see how we could collaborate.

2.3 The real issues about energy

One day before the workshop, I briefly met João Miranda to explain the goals of the “energy” workshop.

Everything turned upside-down.

Before the talk, I was sure that, by identifying a theme that was important locally (the energy crisis), I was proposing something close to their reality and to their interest, as we discussed in the previous section.

However, as he told me, and the students would confirm later, the energy crisis had a completely different meaning for them.

My middle-class take of the energy crisis was, indeed, completely different from theirs. I had a set of possible projects in mind, such as building galvanometers, timer devices, waters heaters, energy generators, robots to switch lights etc. I wanted to work with them on modeling and understanding the energy consumption of a household, and trying to identify the critical devices, looking for implications and alternatives. In addition, by having a model, we could extrapolate them for the city, the whole country and the planet. Most of those things, it turned out, were meaningless for them.

The real issue was a lot different, and constitutes a canonical example of the importance of having multiple media, openness for diversity, a flexible set of expectations, and being truly

³ Hacking here means finding creative solution for problems even when you do not have the right tools or parts. In Portuguese, people call it the “*jeitinho brasileiro*”, or “the Brazilian way out”

open and adaptive to the concepts and interests of the learners and their communities. Many project-based learning attempts pre-ordain the project based upon the educators' interests and culture and then impose.

Miranda estimates that more than half of the households in Heliópolis have illegal energy connections. This was a first indication of one important aspect of the Brazilian culture: the *jeitinho*, a way through which you can solve problems in unusual ways. On June 17th 1996, a tragic fire killed four people, including one newborn baby. Sixty people were hurt and twenty houses burned [Gentile 1996]. The apparent cause was an illegal energy connection.

Six years later, the situation was not that different. More than half of the houses did not have an energy meter, and the rest were paying the minimum fee. However, with the energy crisis, the recently privatized utility company became more rigorous in reading the meters and charging customers. Most of them could not afford the energy bill anymore, and were disconnected. On the following day, they managed to get an illegal connection for themselves – using the Brazilian *jeitinho*.



Figure 1: A view of Heliópolis (left), and the pole with illegal energy connections (right)

The transformers, being designed to handle the “legal” number of energy connections, would eventually malfunction – causing either fires or blackouts that could last for days, as there was no interest from the utility company to come and fix them [Miranda 2001].

After that discussion, my existing expectations were destroyed. If they did not have meters in their houses, why would it be meaningful to comply with the twenty percent cut rule established by the government? If they did not have microwave ovens or a handful of TV sets at home, what could they save? While middle class families were disconnecting their second refrigerator, people in Heliópolis were fighting for their safety and survival. Energy was a completely different issue there, and that definitely changed the direction of the projects that people would do.

2.4 Openness to diversity and alternative environments

As we started the workshop, the first challenge was to find a way to know the students and help them engage in activities they would be interested in, as most of the tools were totally new for them. For me, their life and environment were also new. One of the best moments for knowing ourselves were in fact outside the school, at the *McFavela* (McShantytown), an old snack place nearby the school. I took all the students there for lunch a couple of times. We talked about their lives, their parents, their dreams, their plans for the future.

Departing from the knowledge of the students as people, their life and dreams, I could help them engage in different activities such as moviemaking, music, robotics, scientific research, journalism. They were also getting to know me.

The way the equipment was used was also different from what they were used to. When still and video cameras are seen for the first time, students often get excited. They take pictures of friends, teachers and themselves. They are thrilled to see the pictures available right away, and that changes the whole dynamic of using photography in learning environments. However, that moment of excitement was criticized by some teachers – to their mind, they were just fooling around with the expensive equipment without any specific goal. However, learning digital technologies happens in fundamentally different ways than the conventional curricular content⁴. People often learn much more by fooling around with computers and cameras than by reading manuals. As soon as they get familiar with the tool, they started to think of deeper ideas for projects.

As a result, I left all the material (Legos, arts materials, electronics materials, my own notebook) scattered all over the floor. I showed them some basic Lego mechanisms and how the Yellow Brick⁵ worked. About fifteen minutes later, when I looked back at my notebook computer, two students were already doing some simple programs and downloading to the Yellow Brick. The fact that a supposedly expensive computer was lying on the floor, available to be used, was extremely meaningful for them. That was clear in the final interviews with the participants, when at least half of them pointed out the “freedom to use the equipment” as one of the things they liked most. Putting my notebook computer on the floor and allowing them to use it was one fundamental *displacement* that constituted one of the most important findings of the workshop: the importance, in terms of trust and relationship building, of allowing democratic access to the equipment – and its importance to the Learning Atmosphere.



Figure 2: Kids programming the Lego Yellow Brick, on the first days

⁴ It is true that this also happens with other constructive technologies, such as car mechanics. But digital technologies take this to a much further point.

⁵ The yellow brick is the miniature programmable computer that comes with the Lego Mindstorms kit. It is possible to attach sensors, motors, relays and lights to it.

Nevertheless, that was not their usual way of working. A typical example was the way computer games were handled. The computer lab coordinator always deleted the games from the computers, but the students managed to reinstall them every time. Computer games have a reputation of being a useless distraction. On the other hand, some of the students needed time to think (or not), to observe others without the embarrassment of being alone, or simply some rest. After hours or days of playing Solitaire, the “gamers” started to engage in projects, either building with Lego, helping others out etc. Without the prohibition, playing Solitaire gradually became a natural and eventually less enjoyable activity than building and thinking about projects.

2.5 Multiple media

Two fifth-graders, Monalisa and Gleidiane, were not so excited about Lego, but they liked arts and photography a lot. Monalisa painted a picture in the first day. Then they began exploring the other arts materials, making small figures and miniature furniture in clay. They decided to build a house to put their furniture inside, doing a little claymation.

They were extremely happy with it, but I had a concern: their house had nothing technological. There were no robotics, no programming, no digital stuff. We care about those technologies because they open up many possibilities that conventional material do not allow. I was tempted to give some ideas about how to integrate robotics into the house, but it was clear to me that it would be an imposition from my part. However, something else happened: two other girls, Mauriza and Edilene had the idea of adding up some robotics to the house, like an automatic front door and timers for the lights, so that the house would save energy. The original creators of the house continued together with them for a couple of hours, but then decided to leave and do more painting.

Everybody was happy: one group had found a project in which adding technology *was meaningful for them*, and the other, satisfied with the house, wanted to move to more complex painting challenges. That illustrates that having a multiplicity of expressive tools and a convivial space opens up new possibilities for real collaborative work. The fruitful collaboration between the “architect-girls” and the “engineers-girls” was one example of the synergy that can take place in such environments. Neither group gave away their ownership of the idea and the project, but kindly agreed to share the credit for a collective work, to which each one contributed their own interests. That is, in fact, how adults work on projects, but very uncommon in school. Normally, the opposite happens: schools claim that some of its worst characteristics are needed to prepare students to work in the “real world” [PartBD2 2002], yet the most important part of how people work it is often ignored.

Mauriza and Edilene ended up adding many things to the house. The most exciting for them was the temperature-controlled fan. But we were out of Lego motors. We had two broken tape recorders around, and I suggested them to disassemble them and look for motors. They were so proud to get a motor for free instead of the US\$ 20.00 Lego motor that it became their favorite story.

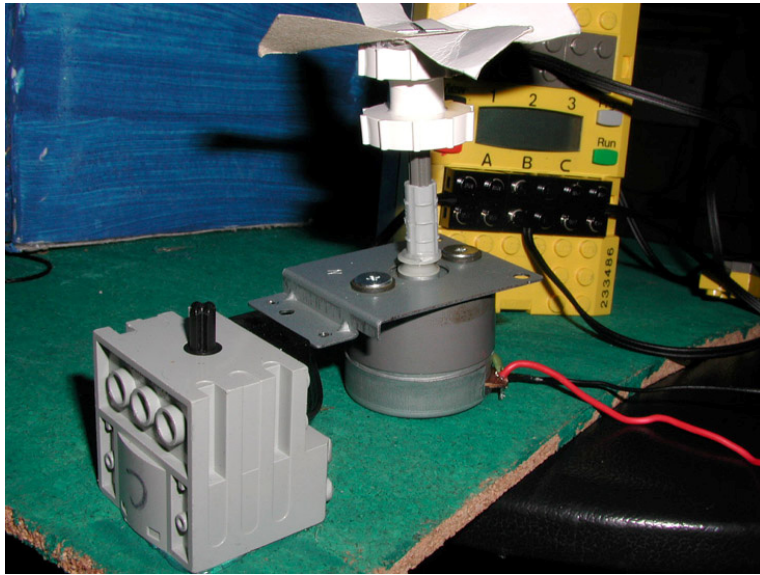


Figure 3: The US\$ 20.00 Lego motor and the free tape recorder motor

Engaging in robotics through a completely unpredictable path, Mauriza and Gleidiane learned about electronics, sensors, fans, architecture engineering, soldering, and voltage. They reflected about ways to save energy. One of the most important parts of the project was that they were not only building a house to save energy, but also their method of building the house was ecological. This demonstrates another important aspect of the learning atmosphere: that the process of construction and learning, and the reflection on this process and the learners' own realization of their growth, is far more important than the end-product.

2.6 Nice... but too expensive

One of the big issues since the beginning was the *price of things, which they would ask many times over the days*. They suspected that a video camera would cost more than the yearly salary of their parents, who were bus drivers, cleaning professionals, homemakers, manual workers in industries, etc. Their monthly household income was under US\$ 300.00 - sometimes much less than that. I told them that a Lego kit was US\$ 200.00, which is more than what many households make each month. They realized that such a cost equation would not work in their school. As a result, the reason to make low-cost materials is not only that it will make the materials affordable, but also that the participants of the workshop would believe in the sustainability of the project – and engage in it in a different way. Using the motor from a broken tape recorder, the girls were at the same time learning to work around problems (the *jeitinho*, so familiar to them, what to do when you do not have the right part) and giving a new meaning for an object seen before as trash. Some of the students (as well as teachers from the school) were happy with the activity, but knew that all those materials were excessively expensive for their school. By the end of the workshop, most of them were using those materials instead of Lego pieces to build their projects – they appeared to feel more proud to assemble things with parts they found by themselves.

Geraldo, a seventh-grader, built a car that was designed to run away from floods and water. He used the cheapest possible sensor: just a pair of wires. He concluded that they would perform well as a water sensor after a conversation we had about electrical shocks in the bathroom when you are barefoot – a completely unpredictable path.



Figure 4: Geraldo and his car (left), and the water sensor (right)

The River documentary and the community radio station

On the third day of the workshop, I proposed to go out to the community with the cameras. Just two blocks away from the school, we found one of the poorest regions in the shantytown: the Bridge.



Figure 5: The miserable bridge region. The sewage from the houses goes directly to the river

Around one hundred people live there, in wooden houses and precarious conditions. Energy connections are also terribly unsafe. The students interviewed many people, asking them about their conditions and possible solutions. The houses were throwing their sewage directly into the river, which had many rats that would eventually bite children.

Then we went to the community radio station, where they did another documentary. The radio station is one of the community's prides. On the way back, they showed their footage to the rest of the class. Part of the group stayed in the school working on robotics projects. Mauricio, one of the boys, while watching the video taken by the other group, saw the big pipes that carried the sewage from the houses. He proposed the idea of incorporating to the end of those

pipes a small energy generator, which could be used to light the place up or just to store energy. He then built this small energy generator with a piece of PVC plastic, cork and small pieces of wood. He attached it to a Lego brick and saw that the energy could be easily stored in a capacitor, with the help of Claudino, who had spent the previous day working on experiment with the Yellow Brick, a solar panel and a capacitor.



Figure 6: The Bridge and the radio station documentary

Some kids did not go to do the documentaries, but by watching the videos they had inspiration for other kinds of projects, and were helped by other kids that did yet more investigative projects. Had everyone been to the shooting of the documentary, as a regular school field trip, that synergy would never take place.

“If I that know everyone has the same information and is doing the same thing, I would hide my project fearing that my colleague will copy my idea. However, if I know that everyone is doing different things, I would not bother if one idea of mine is in someone else’s project, because they are so different.” [PartWI 2002]

2.7 Visits to the university and the newspaper archive

Most of the time, students take school tours to **see** things outside. The idea was to go beyond that: since the kids have built robots, let us take them to a robotics lab at the University of São Paulo (USP). If they did video, we would take them to the university’s TV station. Therefore, the lab or the TV would not be like a museum or an exhibition show, but a place to discuss and get inspiration.

We split in groups and visited various laboratories at the University: energy, solar energy, virtual reality, robotics, and TV station. One interesting and unexpected connection came from Claudino, who was one of the most interested in measuring and modeling energy consumption. While we were having lunch at the students’ restaurant, he noticed that there were small signs next to the food with the caloric value. We had then an interesting discussion about energy in a broader sense, including how the human body generates energy, how food is transformed in energy, how much beans would be necessary to turn a light bulb on etc.

The second trip we did was to the Estado de São Paulo newspaper archive. At first, we did research about energy in Heliópolis, but soon enough students wanted to go beyond that. They wanted to see if there were news about their theater group, or about the movie that had been shot there. The result of the work was quite astonishing. Most of the news they found in the archive about their community was about drug dealers, violence, fires, accidents, and poverty. They were very disappointed about the image that they might have to others.⁷ “What about our theater group? What about the good things that happen there?”

Everyone left Estado upset. I felt that they were quite saddened by their experience of the day and the realization of the public presentation of their community, their lives, and their value. They were feeling that, not only people considered them as *favelados*’ (pejorative slant for inhabitants of shantytowns), but also their place was the most dangerous of the city – and nothing more. It looked like the visit to Estado took them back to reality and their supposedly “right” position: poor kids from the *favela*. However, there was one fundamental difference. We were *already* involved in an empowering **Learning Atmosphere** – where they had much more control and freedom than usual. They were already creating projects of their own choice.

Their response was one of the most powerful moments of the workshop: as the big press was *not* talking in a *fair* way about Heliópolis, *they would make their own Jornal da Escola* (The School Newspaper), to talk about all the cultural events, community projects, and other things that happen there.

A group of about seven **girls**⁸ got together for the project. They asked me how to do a newspaper. We went to a newsstand and bought one. They went through it and designed a plan for their publication: the sections, the possible articles, interviews, formatting etc. They even did the economical viability analysis.

One of the important parts of the newspaper would be a special supplement about secure energy connections. They realized that it was impossible to get rid of the illegal connections, but wanted to help people make them safer. They took pictures of unsafe connections, crowded poles, and transformers, to illustrate the supplement.

Heliópolis was a successful proof of concept. Teachers, the principal, staff from the Secretariat of Education and the Secretary himself saw that, even in a poor community, with little equipment, found materials, local expertise, it was perfectly possible to offer a different experience to the kids, and they would learn about all fields of knowledge.

⁷ One of the girls mentioned in her final interview that she felt very sad when one of the printing press employees said something negative when he found out that they were coming from Heliópolis.

⁸ Girls, during the workshop, were usually in a leading position, which goes against the common idea that technology-rich environments are more suitable (or attract more interest) for males. By offering different expressive tools, we were providing many alternative points: video, journalism, robotics, programming, acting, and painting. This is not only about gender issues, but also about individual styles, histories of life, and preferences.



Figure 7: Unsafe energy connection pictured by the students

3 The Learning Atmosphere

The framework of the **Learning Atmosphere** is an attempt to understand the process of sculpting the aesthetic of a learning environment such as the Heliópolis one. The metaphor of the atmosphere is interesting for many reasons: first, an atmosphere can have micro and macro environments, which not only can be radically different but also can influence one another. Second, although atmospheres surround us, they cannot be touched. They are an organic, interwoven whole that contain many elements from which just a small part is known or visible. Finally, they are **multi-variable**, **meta-stable** and **hard to predict** systems. Being *multi-variable* means that many elements change at the same time or are interdependent. *Meta-stability* implies that all equilibriums are fragile – and a small change in one of the components can make the system change rapidly. Finally, being *hard to predict* does not mean that “anything goes”, but that the mindset of single variable cause-effect is simply not applicable.

Learning Atmospheres surround learning environments, but contain other dimensions as well, which are related to the main findings of this research, which I would categorize in three entities:

- **The choice of what to explore and build.**
- **The choice of the tools to use.**
- **The affective interaction.**

The first entity is related to Freire’s *generative themes*. The second is related to the presence of *multiple expressive tools and media*. The third is related to the evaluation of how *relationships are built along with a learning activity*.

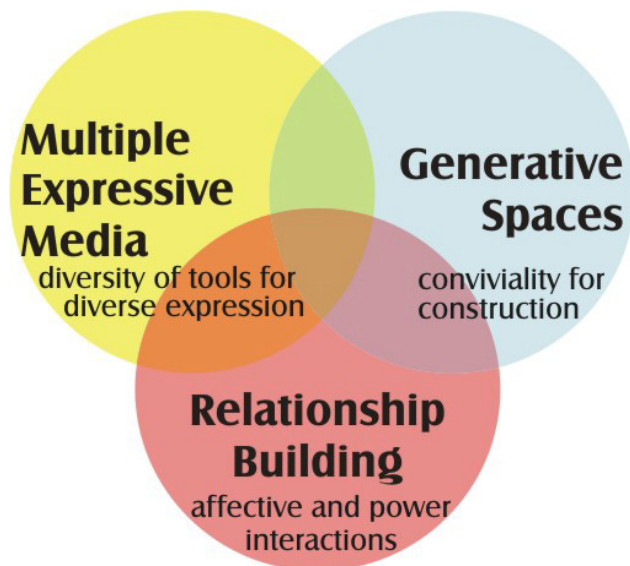


Figure 8: The Learning Atmosphere

3.1 Generative Spaces – conviviality for construction

Paulo Freire’s **generative themes** and his methodology for illiterate adults were certainly one of the most influential elements to most modern progressive educators. David Cavallo comments in his PhD. thesis,

The choice of projects and study by the learner is critical. We do not use projects merely as a means to get them to learn what we want. They are not pre-ordained, pre-planned, and prefabricated within a pre-determined, structured, rigid curriculum, used solely to teach a set of facts or concepts. Rather, their choice is an essential element to a positive, free, active engagement with their world. Instead of relying on the dictates of others, they take charge of their own learning and their own relationship with their environment and each other. [Cavallo 2000]

In “The Pedagogy of the Oppressed”, Freire explains in details his method for coding / decoding elements in the local culture and coming up with generative themes together with the community of learners. He stresses, in the whole process, the dichotomy between being immersed in one’s reality (being only aware of your own needs) and emerging from it (making sense of your needs). He states that the learners can go from the “consciousness of the real” to the “consciousness of the possible” very quickly, as they perceive the “viable new alternatives” beyond the “limiting-situations”.

Freire designed his method while working with adults from extremely poor regions of Brazil in the sixties. They were oppressed, poor and illiterate. Using language and literacy was an attempt to empower them and promote their emancipation, one of the few ways out of their social condition. However, when Freire’s ideas are transported to the school, there is one big difference. Children are oppressed not only by society but also by the world of adults. What space do they have to perceive the “viable new alternatives”, the “consciousness of the possible”? Unlike adults, *who are learning how to read and are making use of that knowledge simultaneously*, children are often enticed into themes or projects that will have *no impact on their lives*, and no relevance to the lives of others. I often heard from students, when I asked about some project they were doing for a class: “it is only a school project – not serious”.

Freire never proposed that the researcher (*investigador*) should not contribute with his/her own themes and ideas (the *temas da dobradiça*, or connecting themes), but he made it clear that the proposition should emerge within a specific context, and link themes already pointed

out by the learners as meaningful. He also never proposed that the researcher should get to the classroom with a list of possible themes in order to achieve a curricular item.

I arrived in Heliópolis with the freirean methodology in mind – but still I had to change everything and be flexible to adapt to their reality – and not the reality I suspected to find out. But how did the presence of digital technologies change the process?

3.2 *Can it happen without technology?*

The first important change was that the students and I could engage in the research about the *generative themes* **together**, using video, pictures, robotics, modeling and measuring tools. This is also because the kids are quick at picking up and appropriating the technology.

Having multiple expressive media and technologies at hand (without much formality and bureaucracy), they could engage in different explorative projects in ways I could never imagine myself.

The second point was to reflect on those issues and come up with project ideas – which required a more active role from the facilitators. The **Jornal da Escola** (the School's Newspaper) was a classic example: we went to Estado together; the students were disappointed and decided to act upon their concerns by themselves. When it came to the implementation, I took them to the newsstand, we bought a newspaper, discussed together how to edit and design a newspaper, and then they went to do it. But some help was needed to get them to a higher level of development of their project.

The question that arises here is: could not all this happen without digital technology? That is where the idea of the **Learning Atmosphere** comes in handy: the atmosphere in Heliópolis, with easily available digital equipment, community leaders coming to talk, freedom to choose projects and a convivial environment was all an integrated whole. The presence of digital cameras and robotics was not just an element that could be introduced or removed, as a variable in an equation. The availability of unusual equipment brought an extraneous touch otherwise impossible, in the Trojan Horse sense – once “domesticated”, it became a great object to play with. In addition, we have to consider their prior attribution of social value, potential, and meaning to this valuable equipment.

Play, to the eyes of many teachers, is a hindrance to learning; it has to be “regimented”. Nevertheless, some teachers knew (and told me) that most kids learned computers only *fuçando* (fooling around), which was not allowed in the computer lab. They often asked the kids for help in dealing with the computer – but could not allow them to learn in that fashion once the activity became official.

The epistemological status of the teachers' comments is revealing. It is not only compatible with the traditional school paradigm, but with the way parents regards school. David Cavallo reports that in Thailand parents complained about one workshop that he conducted, saying that the children were only having fun and thus could not be learning [Cavallo 2000]. The idea is that playing around is bad and leads to nothing⁹. The epistemological belief of the teachers is that there must be concrete goals, plans to get there, and orderly sequences of knowledge construction. One of the biggest breakthroughs in our workshops is when initially reluctant teachers allow themselves to let go and start genuinely enjoying being a “playful learner” again.

⁹ We are not advocating fun for its own sake, out of the context. It is also true that fun approaches leading to nothing are also common.

The more available tools are, the more likely it is that people will find entry points that resonate with them. As a result, asking if pencil and paper could have replaced the video camera in Heliópolis becomes somewhat meaningless within the **Learning Atmosphere** framework. The technological apparatus becomes a core element, which contributes to the spirit of the workshop. It cannot be isolated from the whole. Seymour Papert, in “Computer Criticism vs. Technocentric Thinking” [Papert 1985], discusses this issue when commenting on some of the criticism commonly made to Logo.

The crucial [for the conservative mindset] experiment [...] is based on a concept of changing a single factor [...] while keeping everything else the same. [...] This is the methodology of an educational activist: [...] one introduces Logo and then works as hard as possible to make all other things as different as possible.

Another element is that the presence of objects that have to be shared creates a new dynamic, which is inexistent in regular classroom. In the traditional setting, everything is symbolic on paper; there is no opportunity to develop democratic control. [Papert 2002]

3.3 *New ways to act in the world*

Another important change is that the tools and devices we brought to the workshop were not just “unusual”; they were also rich and unique media for expression, building and simulation/modeling. In this sense, they open up new ways to act in the world. The digital technologies we favor help kids give new forms to their imagination by making “what could be” tangible and shareable. As Edith Ackerman says her paper “Piaget's Constructivism, Papert's Constructionism: What's the difference?”:

[Piaget and Papert] remind us that learning, especially today, is much less about acquiring information or submitting to other people's ideas or values, than it is about putting one's own words to the world, or finding one's own voice, and exchanging our ideas with others. [Ackermann 2001b]

Imagining solutions for the community, was intrinsically leading to social research, reflection and intervention. The latter aspect – intervention, making something *for real* – was an *intrinsic part of the Freirean method* for illiterate adults, as they could use their reading and writing skills in everyday life. Despite rhetoric to the contrary, the epistemological stance underlying traditional school practice is that knowledge is to be deposited in the kids' heads for an (unlikely) future use. Students are never ready, never prepared, never mature enough to put the knowledge into use, and consequently never considered capable of deciding what they should to learn. As a result, Generative Spaces it is not only for up-in-the-air exercises of imagination, searching the ideal, but also a space infused in praxis, in democratic decision-making, in real life.

In the context of our own work on digital fluency, the concept of a **Generative Space** can be described as follows: designing a space where tools are easily available, the control of them is delegated to the kids, where students have freedom to choose their projects, where different media is at hand, where engaging in different and/or simultaneous activities is in the culture, where imagination meets praxis.

Our contribution goes also in the sense that, in order to build a generative space, attention must be paid to certain critical details. We term them *details* because they have routinely been overlooked and disregarded in schools. They could, however, be incorporated into the atmosphere, as it already happens in other settings outside the school, such as a theater group, a soccer team or a jazz band.

One canonical example is the control over equipment: just the fact of having a sign-up sheet for the equipment, controlled by someone from the school staff, affects seriously the atmosphere¹⁰. On the other hand, in some settings, equipment might be too scarce or the risks too high – one possible way out is deciding democratically (proposing and voting) how the equipment or the activities will be conducted.

Stephen Ball, basing his reasoning primarily on the Foucault idea of management as moral technology, states that the teachers are increasingly subject to systems of administrative rationality that takes away their voices in the process of making important decisions, that could happen collectively without any disadvantage. [Ball 1993]

3.4 Relationship building (affective and power interactions)

- **Dependency-generation pathologies**

José Cukier, an Argentinean psychoanalyst, has extensively studied the psychopathologies originated from school [Cukier 1996]. His psychoanalytical approach is useful to understand some of the typical phenomena we faced at a personal level. Relationship building is a far more complex issue than being “nice” to students. Cukier warns us against the demagogical and charismatic educator, who focuses only on the affective link with the students, through seduction, neglecting the educational goal and the content.

Also this undermines the autonomy of the learner as learning becomes associated with being taught by the charismatic as opposed something the learner does and controls [Cavallo 2002]. Fernando Almeida describes how school stimulates a kind of schizophrenia and cynicism in the students, by having them learn to assume different personalities all along the day. [Almeida 2001]

Between the two extremes, the traditional authoritarian teacher and the charismatic leader, there is space for less pathological transactions.

- **“Can I use your computer?”**

One situation we faced in every single workshop in Brazil was the control over the equipment. Some would ask for permission, some would just grab cameras and go take pictures, some would ask for explanations about the operation of the equipment.

We had modern digital equipment, not available for kids in their everyday lives. That is a fundamental test, both for the students and the teachers. The first group was expecting prohibition; the second was annoyed by the lack of control.

Michel Foucault analyzed extensively the role of discipline and punishment in many institutions, such as prisons, schools and mental institutions. One of the common characteristic in those institutions is that power operates automatically: the feeling and the fear of being watched all the time causes the incorporation of the rules dictated within the environment - the panoptical metaphor [Singer 1997]. Foucault contradicted the idea that school evolved following a rational mindset for the good of learning or the students. He states that during its evolution, the negative side predominated, and the main goal was neutralizing and normalizing children, through discipline, punishment, and constant surveillance. One of his important conclusions is about how power is increasingly invisible in modern society, but always present, and needs less and less demonstrations of force to ensure that the rules are fulfilled

¹⁰ During the Winter Institute, in Curitiba, the equipment was controlled by the receptionists of the event, supervised by staff from the Secretariat of Education. We found out that, as battery life of the digital cameras was short, the chief-receptionists decided (on her own) that only the adults should be able to get the cameras.

(*apud* [Singer 1997]). This is accomplished mainly through discourses within the schools - what can be said, who can speak, who is in control, who really decides.

- **Democracy or meritocracy?**

Meritocracy seems to be one of the cornerstones of status and reward in schools. We observed many examples of how meritocracy turns into exclusion and destroys the learning atmosphere.

Still, in any learning environment, there will be conflicts. How do we solve them? How to decide who has the camera? The way the teacher/facilitator decides those things are also tests for the children. They understand the decision process and adapt quickly.

In our experience, students realize quickly how to get what they want: either by seduction, praising the teachers, making him/her guilty etc. However, I had real power: I could decide who would use the equipment, how we would organize, how we were going to work. A hypocritical way to do things would be to pretend that I had no power, no veto, or was just an observer. However, I did not want to make kids depend on my decisions and feel disempowered about taking their own.

The solution was to *use my power to share power*. I decided to use my position to establish a principle: *there will be no privilege*. I was not giving out my influence on kids or pretending that I did not care about the equipment or the work. However, by setting up a principle, I shared with them the remaining decision power. When they asked about the camera, I gathered them and asked to propose different criteria, and vote. Not all students were satisfied with that, but they understood that neither seduction nor praising would work, but only engaging in the democratic negotiation. As Watson declared in 1957:

A teacher may be, for example, a direct love object, a strict super-ego figure, an ego ideal, or an ego-helper. Almost regardless of what the teacher intends to be, each pupil will, at first, project upon his teacher a role that arises out of the experience of that child with other significant persons. [...] Whether the pupil learns, and what he learns, depends in large measure on a variable factor which pedagogy has blithely taken for granted. [Watson 1957]

The idea of a **Learning Atmosphere** implies that “details” are as important as most explicit core principles. The relationship-building process, observed in the fieldwork, reveals that children are actively learning how to navigate in new learning environments. The depth of their involvement depends on the way they perceive respect, openness to diversity, trust and real decision-making.

3.5 Multiple expressive media (diversity of tools for diverse expression)

The popular view about technology, as we saw in some private conversations with teachers and staff, is that it is a risky tool. Although we should know about it to operate in the world, technology takes away good things about physical presence, personal contact, manual work etc. Some would agree that technology is good to learn to get a job, but in general, it is a threat to our human condition. This is a comprehensible concern, as most technologies come from other countries and do take jobs of people, in Brazil. Technologies are also often non-affordable in poor areas.

However, technology can also be a fundamentally humanizing tool, if we remember Pierre Lévy’s statement: “*it is the intensive use of tools that constitutes humanity as it is*”. For us, having multiple technologies within a learning environment is exactly augmenting and making possible many activities considered as inherently human: creation, expression, interaction. It is precisely the monolithic use of one single technology allied to one kind of epistemology, which control is not also in the hands of the learners, that is dehumanizing. It is not the ma-

chine that dehumanizes, but the person in control, when he/she extracts the power from the learners at all levels. Of course, we can have a great sculpture, flute or moviemaking class, but we cannot assume that everyone has to be interested in that. Having multiple media means that you can aggregate more people to the activity, see the synergies come up, see people transitioning from one media to another. The activities we promoted are not meant primarily to teach people a particular skill.

By offering multiple technologies and media we are offering more than nice technological gadgets – we are providing the tools that we believe to be potentially humanizing in an atmosphere to support such development. We do not bring all technologies in the world, but a subset that we believe are more expressive and constructive. In addition, the presence of multiple expressive media is not important to train students to use technology, but as the Brazilian psychoanalyst Nize Maria Pellanda states:

“We do not learn about reality by direct experience, but through reconstruction. For reconstruction to take place, we need a full interior symbolic apparatus so that we could make sense of experience. An atmosphere poor of signs reduces the chances of flexibility in the interaction with reality and lacks raw material for us to rebuild the universe inside and outside of us.” [Pellanda 1996]

Although digital media offers revolutionary possibilities for learning, it does not follow that it is the media of choice for all projects. An important distinction has to be made: the *presence* of **digital technology** is fundamental, but its *exclusive presence* is not necessary. The presence of **digital technologies** mixed with **traditional, familiar, hi-tech, low-tech media** is more powerful. In Heliópolis we observed that students would stay for days working with paint and clay before engaging in some technological endeavor.

3.6 The culture of repurposing

Especially in public education systems, flexibility is a key point. We did not want to deliver the message that we were forcing the Secretariat to buy a certain kind of equipment. Thus, mixing familiar, found, broken materials was extremely important not to give the impression that we were talking about turnkey or prohibitively expensive solutions. At the same time, Brazil has a deep tradition of re-purposing objects and finding creative ways out of hard problems. It seemed like a perfect fit.

We had some broken and found materials at hand. The students disassembled and repurposed them. Edilene used a motor from a tape recorder to replace a US\$ 20.00 Lego motor. Diego used a broken game controller to control his prototype house. Mauricio built an energy generator using found tubes and soda cans. It was so natural for them to do it that, after some days, they were bringing things on their own, getting advice from brothers, sisters and cousins, going around the school and collecting broken toys.

- **Eclecticism and adaptation**

Gleidiane, from the Heliópolis workshop, liked to paint. I saw no point in forcing her to incorporate technology in her work. Claudino had the idea to do a checkers game, using cork pieces and paint. Maurício wanted to write poetry, Luis to be the reporter, Herbert to build cars, Roseli to sing and write about her church.

How could I reconcile all those interests yet maintain a certain coherence? *The answer would be that the unity should be moved from the tool or the content to the atmosphere.* That kind of coherence is more powerful because of its flexibility and adaptability. That was why I proposed to the staff of the Secretary of Education to stop naming the activities a *Robotics Workshop*, but *Project Workshop* instead. A workshop about a tool (computers, video, and robotics) is dependent on the availability of certain technologies and human resources. If we focus

on themes or content, we risk being too traditionalist, forgetting the technology and ignore the local context. Neither are good intervention models especially for countries like Brazil, with few resources and high contrasts.

The available tools and resources will change from place to place, but that is not a serious problem if the spirit remains. Some schools in São Paulo do not have video cameras, but have better computers. Some do not have digital cameras, but have a strong community link. Teachers teach in different schools within the same days, where students, resources and the neighborhood change completely.¹¹

4 Conclusion

The discussion of the case studies demonstrated the importance of the three elements of the learning atmosphere framework, and demonstrated the possibility of giving students a different and powerful experience that builds up from their local culture, history and expertise. However, broad-brush strokes cannot do justice to powerful ideas in learning.

The energy crisis in Brazil was the canonical example. I have lived in the same city for my whole life, knew the culture, the place, the history. Yet the perception by the students and residents from Heliópolis of the crisis was completely different. The impact was considerable, but in a different way. I had to understand what was important and familiar to them as a group and as individuals, such as the strong political engagement, the re-purposing of materials, the *jeitinho brasileiro*. But I learned that only building on a superficial view of local culture, by introducing learning methodologies such as project-based approaches, by making available potentially expressive technologies, was not enough to create the displacement that would make people pay attention, challenge underlying assumptions, and work in new ways.

Expressions such as “local culture” and “community development” became quite fashionable in the public debate around education. However, local culture is not automatically positive. Community values are not all virtuous, as many author already demonstrated [Taylor 2001], [Eiles 1996], [Chanlat 1992]. *Catalysts are important*.

It was essential, thus, to have a more textured, fine-grained approach, and identify also what was *not* in the culture. The challenge is to use technology, which was extraneous and foreign, as a means to reinforce community's own livelihood, and create enabling spaces for mutual enrichment.

As a result, technologies, and particular ways of using it, were the main elements of displacement. We showed how they play a central role in the process, enabling new, complex, diverse ways of learning and thinking, both on and off-screen, with familiar and unfamiliar materials, using high and low-tech tools. In addition, the atmosphere enabled new ways to simultaneously manage epistemological diversity, create trust and empower students and teachers.

I brought modern technological devices, but also trash and *sucata* (found materials and broken equipment), as a way to build on top of the culture of repurposing of materials (the *jeitinho*). The learning atmosphere generated the self-confidence, openness, trust and the neces-

¹¹ The other element of unity came from Fernando Almeida. His opinion was that the link between the after-school activity that we were doing and the daily activities at the school was the community. After-school workshops fail to integrate themselves into the culture of the school unless a link exists – in this case, he believed that interdisciplinary projects, focusing on the community problems (as the “City that we want” project), within the regular class time, could be the connection with the workshops that we were conducting.

sary displacement that is fundamental in a country where the Oswaldian¹² anthropophagi is rule, where innovations are received and quickly “tropicalized”.

That was one of the most important lesson of Paulo Freire, when he wrote about literacy. Although his ideas have often been used in very different directions, Fernando José de Almeida gives us some hope

The time between intention and gesture is the time of History. History that is not fate, but political struggle. Fight of people that are utopists, Paulo Freire’s way, who know how to denounce inhuman and unfair realities, but also to announce a new world that could make everyone happier. [Almeida 2002]

Children and teachers know well the script of “change in education.” We wanted to give them more than the script. We invited them to be actors, directors, scriptwriters, and collaborators.

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¹² Oswald de Andrade was a famous Brazilian writer that wrote the Antropofagist Manifest in 1928.

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