Chapter 1

Introduction

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A shift of control

We live in a complex world. The powers that propels the society and the speed at which changes are happening are constantly changing. In these recent years a shift of control has come in the way people learn. We live in the Access Era, where people are enabled to access multiple sources of information and documentation. Learning is part of this revolution because people want to take charge of their own development. The old paradigm of *transfer of knowledge* is broken, people can structure their learning process, deciding modalities and timing, deciding the way they want to explore a concept and how to relate concepts in their own cognitive grid. We register a shift in the way old disciplines are presented and accessed by people: internet , satellite TV, specialised review, journals.Moreover the control of your own learning is becoming a necessity for the speed at which old jobs are converted into new forms of employment.

With these new possibilities offered by new communication channels and access to information, people can increasingly take charge of the knowledge about their own well-being and the well-being of the environments in which they live. In addition, this new awareness produces a change of view in the way people perceive their role in the world. In fact, with this shifts of control come shifts of responsibility and may emerge a new awareness of one's person responsibility in regard to environment's pollution,

politics, social position.

In this context, new representational strategies can translate information so people can understand it in their own ways and so, contribute to this changeover. This thesis, in fact, is just an attempt to look at simple tasks, like plant keeping, with these new eyes of *knowledge construction*. Here new strategies of representing plants and their surrounding environment will be proposed. This work can be considered as an attempt to use new technologies, new media to produce and support this shift of control.

From the outer world to the inner environment of one's room

The goal of this thesis is not to concentrate on the big systems but on very concrete examples in which informal learning can make the difference in the way people learn. For this reason, during my work at MLE, I concentrated on the plant keeping activities that everybody does in a house environment, trying to support the exploration of the plant ecosystem as inscribed in the bigger house-room-ecosystem.

The room in which a person lives can be abstracted as a self-contained environment with proper dynamics and inhabitants. Temperature, humidity level and light conditions are perturbed as in the outer world. People living in the room are also perturbing this environment: breathing, for instance, increases the humidity in the room, the human body emanate heat, affecting the temperature levels in the room, finally the light bulbs present in the room and/or windows can modify the light conditions.

Any pet living in the room is going to be part of its ecosystem. A plant is not different form an animal, it has only different dynamics but is a living being: its biology does not allow the plant to modify directly the temperature but, it influences the humidity level and so, indirectly, the temperature conditions.

The health of the plant reflects the life support conditions of the room environment. If the plant is not healthy this may reflect a bad oxygenation of the room, or severe conditions of light, heat and humidity. The is a concrete correlation between the room-system and the plant-system because usually a room is 10-30 m^2, and walls and windows provides enough insulation form the external world. Subsequently, as a

first approximation I considered a room environment as a self-contained ecosystem, with its proper dynamics and i tried to simplify the exploration of the plant organism inscribed in its world.

In fact, it is usually difficult to understand how the environmental variable affect a plant's life, or, at least, how to tune and control these conditions to provide the best environment to our green friends. We know, from oral tradition, that we have to give water to the plant and that we need to keep the plant warm and in the right light conditions but this is usually it. Conversely, variables interactions are usually complicated, sometimes also in good light conditions we do not get the best growth results because the way the variables mix and influence the plant growth are difficult to predict.

This thesis wants to intervene in this precise context, trying to provide a framework, a technology and a toll which can help in the 'variables affecting a plant growth' exploration, in doing plant keeping and above all in constructing a personal knowledge of these phenomena.

A plant's world: limits of an interaction with a plant

When we interact with a plant we experience several dynamics which I consider limiting the learning experience with the plant. Firstly, you cannot manipulate the plant with too much energy because of its fragility. Is not possible, for example, to shake the plant to throw the plant, etc., without causing severe damages to its integrity. In this sense the manipulative experience you can have with the plant is reduced (see [Eyster and Tashiro(1997)], or [Sowell(1989)]). Secondly, plant are slow in responding to climatic/environmental changes. This reflect in the way a learner may build cognitive connections between a perturbation on the ecosystem and the corresponding effect on the life of the plant, which is the corresponding qualitative and empirical approach of the exploration of the plant's biology. Thirdly, a plant is a complex world in its own. Lots of environmental factors concur to generating non-linear forms of growth. Using empirical observation for grasping the underlying laws and connections is usually not enough.

Several variables interact at the same time to generate the outcome of a plant's life. Model these variables is not an easy task for research and, moreover, for empirical observation. Lots of simplifications are needed in order to concentrate on the core concepts driving the growth of a living organism. Technology can can be at hand in this simplification process, providing the computational power needed to isolate conditions, speeding up processes, and taking track of the outcomes. This was the attempt of this work.

A new media for exploring the plant's world

One of the aims of the Biosphera and the DigitalSeed project is to expand human potential in the observation of a plant's life. in fact, these microworlds i have designed, support the learner, the user, during the observation of the plant, enabling a *comparison* between different sets of inputs and outcomes into the ecosystem of the plant. another mayor feature of this system is to speeding up the biological processes of the virtual alter-ego of the physical plant for real-time observation, and finally this technology allows the user to reverse processes that usually are unidirectional for manipulation and exploration purposes. This kind of abilities are not possible for the human abilities, so technology is considered through this work, as a tool for sustaining human exploration, allowing new kind of enquiry.

Biosphera and DigitalSeed are new media, in the sense that support new human abilities, the ability, for example, to observe invisible phenomena, to speeding up biological processes and to make comparisons usually impossible to do. the purpose of this thesis is also to provide a stimuli to the research in this field and to use also these new media, these new technology as research tool, to study deeply the cognitive experiences people have during their interactions with plant and the kind of understanding they can gain with new tools supporting them.

An outline of this work

it is not my intention, in this work, to make claims about the scientific effectiveness of the technology usage proposed in this thesis. Rather, this work has to be considered

as a report of a design exercise coming after two years of study and research at Media Lab Europe. The proposed solutions, in fact, have not been tested longitudinally to draw any scientific conclusions.

The second chapter illustrates an interaction scenario of the usage of the Biosphera system, trying to give the reader some more example of how and when this technology can be used and for which purposes. This chapter give me also the opportunity of discussing a matrix of cognitive experiences the user can have while comparing plants grown into the system from plants grown outside the system and combinations of those.

The third chapter will discuss the theoretical background of this work giving support to current status of research behind any hypotheses raised. These sections will analyse all the aspect of the human interaction with plants and research questions and claims collected during the literature study.

The fourth chapter will illustrate the design of two implemented microworlds: the Digital Seed and the Biosphera system, explaining how any technical solution chosen is related to the theoretical study of chapter 3 and how the design is going to support the hypotheses.

The fifth chapter will detail how the design proposed in chapter 4 is born from the collaboration with several groups of children which have participated to some design session at MLE, and how their ideas stimulated the design of the final objects. In addition, this chapter will try to report the historical evolution of the projects through several stages of development.

The last chapter will draw some conclusions of the entire work, with some space for future development.

Bibliography

[Eyster and Tashiro(1997)] Eyster, L. S. and Tashiro, J. S. (1997). Using manipulatives to teach quantitative concepts in ecology: A hands-on method for detecting correcting misconceptions about limiting factors in eutrophication and vegetarianism. *The American Biology Teacher*, **59**(6), 360–364.

[Sowell(1989)] Sowell, E. (1989). Effects of manipulative materials in mathematics instruction. *Journal for Research in Mathematics Education*, **20**(5), 498–505.