About Procedural Computing: The Roamer Robot

White Paper by Daniel Jacquet Professor at CNEFEI, Paris, May 18th 1998

SUMMARY:

The approach called procedural computing applied to pedagogy, with the development of activities linked to Logo language, experienced during the eighties in France, a strong flood of interest followed by a just as abrupt ebb during the following decade. Some experiments with a British designed robot, the Roamer gave a CNEFEI team the opportunity, with other professionals of the AIS, to develop an interest in the steps associated with this type of tool- presently almost totally ignored in France- with disabled children and youths.

The first observations tend to show that the pedagogic robot is very pertinent and can be used profitably with youth from the AIS; but for this its modes of utilisation must be re-thought and developed, depending on the public, to be integrated. An illustration of the development steps with the Roamer applied to a specific public of handicapped youths with the after-effects of cranial trauma is developed in a second part.

KEY WORDS

Abstraction- Procedural computing- Logo- Active pedagogy- Resolution of problems- Robot- Cranial trauma.

PEDAGOGIC ROBOTS

What origins, what uses, what perspective in the field of AIS?

We can observe, from reading what follows, that innovation sometimes follows detours and it is the right moment to come back to what we already know- or we think we know well enough- to perceive more correctly the interest of one “ex” novelty, which was partially forgotten. It is, in fact, a kind of rediscovery for the CHEFEI team who is interested in the robot’s pedagogic vocation, baptised Roamer by its British designers.

It was during a meeting with Eric Greff, Teacher trainer at the IUFM of Versailles that we came to know this robot. This teacher, having some time before completing a doctoral thesis on educational software, had discovered this product in Great Britain with a strong link to his research. He wished to share with us his curiosity for this, with the idea that this tool would be of interest to the practical adaptations for the public of the AIS. Which public and which adaptations? This remained to be explored and determined. To be honest, our first impression of

this machine was not immediately enthusiastic, but created a vague curiosity limited by the impression of déjà vu. It was only after a second look that we saw the potential of this tool, beyond the prejudices based on previous bad experiences.

Procedural computing: A missed appointment?

For those reading this who doesn't know the problems with pedagogic computing in the eighties, because of their age or other preoccupations then, it is necessary to go back. At the beginning of those years, we hear of a "new" idea in the school with the arrival of the first computers: the child is an actor in his learning, he builds his knowledge himself, learns through action, experiments and computing will give him the means. Seymour Papert, a psychologist and mathematician, researcher at the MIT (Massachusetts Institute of Technology) and disciple of Praget, is the prophet of this philosophy. His book, "Computer- spirit effects and learning" (Flammarion 1981) makes a lot of noise. The major tool of this paradigmatic change is a computer language, Logo, whose characteristics are presented as giving a particularly favourable context for the development of diverse competencies, especially reflexive, critical and methodological. Of this language, we often only remember its graphic component, the programmed movement on the screen of an isosceles triangle identified as a turtle (as well as other virtual elements called in.) which traces different geometric shapes; in fact the possibilities of Logo were going far beyond this but this functional wealth might have been seen as an excessive complexity. Moreover, a more concrete version of the turtle was developed in France by the Jeulin Company, as a robot with a transparent shell, moving on the floor. This "ground turtle" programmable by a card-reading system was a little successful, especially in nursery school and this, even with a defective reliability. Logo itself was a widespread language in many computers from IBM's to Apple's personal computers, without forgetting Thomson, which were in most French schools, especially during the famous (and controversial) CFA plan (Computer For All, 1985). With the launching of this ambitious governmental plan, this language and the projects related to it were highly encouraged within the National Education. In this respect, Logo, its tools and processes were for a while largely presented and prescribed as computer practice indispensable for all primary school teachers. Armed only with their enthusiasm and a sometimes basic or non-existent training, many teachers went into the adventure with varying degrees of pleasure. Many enriching pedagogic situations were created by these pioneers and well experienced by the pupils. But it wasn't always the case and the fervour finally calmed down.

The reasons for disillusionment

Many factors led to deception and weariness, and progressively to the semi-abandonment of Logo and finally it was forgotten. Today a single exploration on Francophone internet with an immediate search engine is enough to notice the absence of information- and of activity- on what was, for a time, one of the spearheads of the emerging pedagogic IT.

Let's analyse here the possible reasons for this disappearance. We can note:

- The lack of reliability of the first equipment as well as the high cost of the ground turtle (about 10000€ in 1987).
- The lack of training and lack of stepping back towards the practice created an inefficient understanding of a complex tool despite an easy first impression. The poor knowledge of Logo as a pedagogic tool in a theoretical context sometimes had as a consequence practice built from superficial notions.
- Some zealous, with excess of enthusiasm or even a lack of discrimination in the speeches and practices encouraged- as in a mirror- violent criticism of these distracters and disqualified practices which were to be constructed, consolidated and validated.
- In geometry, which was a field (too) often privileged, (justified) criticism on the risks of confusion caused by Logo concerning the representation of angles.
- Later, with the evolution of computer techniques, the attraction of computers and multi-media software, apparently easier and more attractive to implement. With CD ROMs, everything is (or seems to be) already pre-built; the teacher only needs to accompany the pupil. This new situation, which will eventually worry some, seems to be a comfortable advantage in a context where pedagogy integrating new techniques can seem difficult.
- Finally, the evolution of ministerial orientation for computer tool, more as a support than as a learning object. The Logo approach appears linked by its algorithmic dimension to a technical learning, which isn't recommended anymore.

The beginning of the nineties is the end of this procedural computing linked to Logo. Only recently, some wondered whether we didn't (apologies for the expression) "throw the baby out with the bathwater". In exchanges with former actors of this pedagogic agitation, who now have other commitments, they told us about their regret and conviction towards the relevance of this approach.

Other places, other approaches.

Looking outside our borders we saw that the French situation was not similar abroad, especially in Anglophone countries where the Roamer robot has a different dynamic. In fact in 1989, this pedagogic robot started being commercialised. At the same time in France , the practices coming from it fell off. Since then more than 85,000 robots have been commercialised and used in schools in the nineties, mainly on the other side of the Channel (but also in twenty six other countries, sometimes very far: some Roamers have been bought for schools in Shangai). This shows a very different evolution. The British pedagogic politics- more decentralised than in France- has probably something to do with it.

The Roamer, detailed review

The Roamer, in English is one who wanders the streets, a vagabond, or someone who explores the world. We note that it is a machine whose main characteristic is linked to space exploration, and measurement. Since 1999, this robot has been imported to France by the company Nathan and has been renamed Logor. Considering the derogatory (and, in our opinion undeserved) representations of out-dated and surpassed technology associated with Logo, and wishing to

distance this model, which has been renewed, we regretted this explicit reference. We liked the name Algor chosen by E. Greff in his thesis (1997) to refer to his virtual robot; for this article we preferred to keep the original name.

The Roamer (Logor) is a grey, 30 cm in diameter, and lentil-shaped, plastic object with two-wheel drive on its lower part and a bright control keyboard on its upper part. In the centre, there is a gap to put a tracer, with an on/ off button (it works with batteries) and a plug to link it to a PC with a cable; optional software Roamer World allows control from a PC. The robot can have other optional elements: tracing kit, different coloured shells, pedagogic files, movement pads (foam paving), an entry/ exit module to add accessories activated by programming: lamps, engines, sound, light or contact detectors, etc. It is regrettable, that these complementary elements haven't been imported (or translated) by Nathan yet.

Control elements

The Roamer basically knows how to move. It can also emit sounds and- if added the entry/ exit module- can be programmed to control or act according to the information received by peripheric elements (lamps, engines, sound, light or contact detectors, etc).

The Roamer can be entirely parametered and programmed from the keyboard. There are five different coloured keys on it:

- Yellow, numbers 0 to 9.
- Green, to launch the execution of programmes stored in the memory.
- Red, two keys to erase. One erases the last command, the other the whole memory.
- Blue, on one hand, four arrows to move forward, backward, turn left or right. On the other hand four keys to repeat the procedures and pause when moving.
- Finally, there are some pink keys, whose use is rarer or even non- existent. They allow the transmission of notes and sounds as well as the programming of the peripheric control module, not in the standard Roamer.

The adjustable, moving units are:

- 30 cm for linear movements: one step of the Roamer corresponds to its own diameter. It gives the children a concrete perception clue and is easily integrated.
- A rotation degree: this adjustment is in general non-significant for children and for most activities, it is set on 90°.

The basic syntax is as follows: one instruction (or command: 1 blue key) + data (or argument: 1 or 2 yellow keys). A mistake in this syntax (for example, data missing) and the Roamer gives a sound warning.

For example, to programme a square (specialists recognize the archetype of Logo), we'll proceed this way: ⇑1 ⇒1 ⇑1 ⇒1 ⇑1 ⇒1 ⇑1 ⇒1 (go forward one step, turn right 90°, etc) or this way R4 (

⇑1 ⇒1), other forms being possible. In the second case, we use the repeat control (R) to do 4 times the same set of instructions.

If we want to compare Roamer and its French predecessor, the Jeulin turtle, we see many differences, more or less important, such as its price (around 370€) a lot cheaper than the turtle. But, whatever the differences, there is an obvious fact: the Roamer has the advantage to exist, to be produced, when the other one has not been manufactured for years. It is even, to our knowledge, the only pedagogic robot of this type currently available on the national and international markets. Another asset is the dynamism of the English team at Valiant Technology, its will to see this creation evolve especially towards audiences with specific needs: the work started in partnership with CNEFEI is a sign.

Roamer: What objectives and what fields of application

We can essentially consider Roamer as a computerised aid to solve problems and develop procedural reasoning, a concrete support for abstract learning. Its objectives and fields of application are therefore the structuring of thought, representation, symbolisation (coding-decoding), analysis, anticipation and planning of actions (simulation). It can be used for notions linked to time and space, numbering, but also contribute to the development and expression of the child's creativity. The context or scenario of the actions of Roamer, tour by school bus, a hero pursuing his quest, pet or artist, there are many opportunities for the imagination to express itself in a structured activity. This approach, associating emotional and affective aspects to cognitive ones, is a powerful inductor of motivation and concept memorisation.

Roamer, what relevance for AIS?

Roamer wasn't designed for an audience with special needs; we wanted to know if it could become an object generating relevant pedagogic and rehabilitation activities for different professionals, teachers, educators, rehabilitators (psycho-motor, occupational therapists) in different contexts with children and young disabled. For two years, some of them have agreed to play a game of exploration work with the Roamer. The children participating in these experiments were mentally handicapped (trisomic children mainly) or motor-deficient with associated problems (IMC children, cranial-traumatised adolescents) and sense impaired (blind children).

Pretending to give an account of the different works, even schematically, would be an illusion. An illustration in context with detailed analysis is given in following pages. Let's just note that first, adults were reserved about the relevant character of this tool for young people. The diverse worries expressed in the first place were about:

- The possible in adaptation of the robot to the abilities of some young people (mentally handicapped particularly) because of the complex controls and the level of abstraction required.
- The foreseeing of a quick boredom because of difficulty to renew motivating situations with a robot, which only moves around.

- A comparison done by the children which would be to the disadvantage of Roamer with respect to the multi-media computer already used in class or at home, more attractive or offering varied activities: children being used to these multi-functional systems could be put off by an object with few abilities and hard to manipulate.
- Inter-face elements not very convenient (no saving possibilities of the programs without a PC, problematic keyboarding with visual or sound returns) or clearly in-adapted ergonomics (membrane keyboard for motor-deficient or blind children).

But, the results to keep in mind after several months of regular experiments show that for children of different groups, they have tackled the robot without problems, with curiosity never denied. To our surprise, the enthusiasm at the beginning continued over the months, the majority of the children accepting with interest to be confronted by an object or situation requiring rigour, thinking instead of acting immediately, the necessity to face difficulty in the elaboration of a project. For the professionals, the activities built with Roamer (space exploration, distance appreciation, circuit project, problem solutions) led them more than once to review their evaluation of the pupils, allowing them to know more precisely the competencies, lacks and functioning for each one. In some cases, we notice real school unblocking, the robot being a powerful object for learning poorly invested in until then. The situations created, leading to cooperation, verbal exchanges (hypothesis, analysis) favoured the groups dynamic.

Moreover, the symbolic value brought to the children using this object is undeniable; we can suspect that the novelty, rarity and originality of the object have a role. The real obstinacy, the renewed motivation to use, manipulate this machine despite the difficulties - cognitive, perceptive or motor sometimes underlined by the conception of the object itself- shown by the children surprised us, in their desire to experiment and understand, to control and their joy in success.

What future for a pedagogic robot?

For the future, there are two determining points to retain: Valiant Technology, creator of the Roamer, who has partnership links with CNEFEI, is working on a new robot. Sensitive to the necessary adaptations and improvements to be integrated to better correspond to the specific educational needs for young handicapped, it plans to take them into account with the indications given by the diverse experiments. We suggest, for example, the integration of a vocal synthesis. This device, allowing the robot to say what it is doing when it is doing it, and also when inputting or editing a programme, gives in these cases a useful return, especially for visually and mentally impaired children, and allows the widening of the range of exercises, for example by changing the roles (the child does or represents graphically what the robot says). This additional competence, added to other functions and adaptations linked notably to ergonomic elements related to handicaps and specific difficulties would be an advantage for an adapted pedagogy.

Concerning this, let’s note that in a recent report (Information and Communication Technology in Special Needs Education, November 2001) by the European Agency for the development of education for children and teenagers with specific educational needs, the pedagogic Roamer is quoted among the material to be developed towards the education for public with special needs.

Finally, these pedagogic practices linked to procedural computing have to find a real place among all the activities using IT. Multi-media and more recently the Internet, being on the front stage, produced an effect of clouding, shadowing an uncommon object with a specific pedagogic vocation (which they are not)- we can only wish to have practices and reflection made and renewed around it. For this, the CNEFEI, organized a study day on the 4th of December 2002. But, we have to acknowledge a real difficulty to stand practices against a unique object, which has no other existence than in the pedagogic field and which doesn't rely on the support of a flourishing market which stimulates the economy and the fantasies of modernity, unlike computers or digital audio-visual equipment. Therefore, the teacher, educator and rehabilitator can be led to choose to integrate the pedagogic robot among his tools, away from fashion, a thoughtful choice of conviction, founded on the interest of the learners