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A pedagogical experience based on a alternating psychological approach: Example of a “walking robot” student design project

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Abstract: This paper first show the complexity of the psychological aspects of teaching. The modification of the student’s behaviour since a few years obliged us to redefine our pedagogical strategy and to find other ways of teaching. Thus, this paper explains how to improve our efficiency using the Hermann brain model. Then, an application example is given to illustrate the Herman approach: the Toddler (a small "walking robot" of the parallax inc. company) is used to study the embedded system and multi sensor fusion concepts.

Key words: real time processing embedded system, multi sensors fusion, walking robot, pedagogical experience, Herman model.

1. Introduction

1.1 ENSEIRB learning overview

1.1.1 Classical teaching methodology

Since a few years, a deep pedagogical reform is engaged as well on the bottom as on the form. All the scientific, electronic, and other engineering fields of the ENSEIRB program will have to be reformatted. Indeed, technical progress increasingly faster and the diversification of the applications, require a total redefinition of the courses. This can give to the students, an impression of "undulation" or of difficulty in affirming a coherent pedagogical program. In front of this phenomenon, the students and the teachers are sometimes diverted, show incomprehension and are no more motivated.

1.1.2 The students

In parallel, we have attended for a few years a change of behaviour students. The teachers are in front of a new kind of public and do not know how to manage behaviours which are not familiar. Among the major evolutions, one can quote the modifications of the cycles of attention of the pupils. Two tendencies appear:

- Reduction of the long cycle of attention (inherent in human being and normally about 45 min with 1 hour): on a traditional course of 1 hour, we observe a progressive unhooking of the audience faster than before.
- Multiplication of the short cycles of attention. These one duration cycles from 6 to 7 minutes, are also inherent in the human being. They have appeared however more openly since a few years. They are concretised by successive unhooking and accosting during the course, phenomenon improperly qualified of "zapping" by some.

We also observe a global disaffection for theoretical lessons while practical approach is always well received.

At least, we notice, from national statistics, a global loss of motivation for the scientific curriculum. Economical, commercial studies seem to be now more attractive for this new generation of students.

1.1.3 Supply and demand

According to the exposed elements, it appears that supply and demand as regards teaching, need to be given in phase. As the previous teaching methods doesn’t match anymore with these students of today, we have to test other teaching methods to recover quality and efficiency in front of the international competition.

1.1.4 Stakes of tomorrow

All the problems of the stakes are summarised with only one sentence: how to motivate and interest the students (and teachers)?
Of our ability to answer this question, depends the quality and the effectiveness on future Teaching and the future of Teaching. [1]

2. Impact of the psychological aspects

2.1 Hermann psychological approach

2.1.1 Simplified description

Ned Hermann, past manager of the formation at General Electric Company, developed a technique making it possible to easily know the cerebral preferences of an individual. This universally recognised method is intended for better understanding the preferences of an individual like his approach to particular problems.

It results in a representation of the human brain into four quadrants which correspond to the main four preferences of the individual.
Quadrant A (blue) shows the preference of the individual for logic, modelling, (typical profile: mathematician, data processing specialist …)
B (green) its aptitude for the practice and planning (real time production scheduler, administrative profile…).
The quadrant D (yellow) shows the preference for the risk and projection in the future (typical profile: "start-up" manager, risk manager, artist…),
And C (red) for the relational one, emotion (typical profile: social and commercial workers…).

32 different profiles have been identified. As there is no therapeutic or medical exploitation, we can say that is no good or bad profiles, there are only different profiles.

If this model [2] is well known by the business and commercial engineer school, it is not the case in the scientific curriculum.

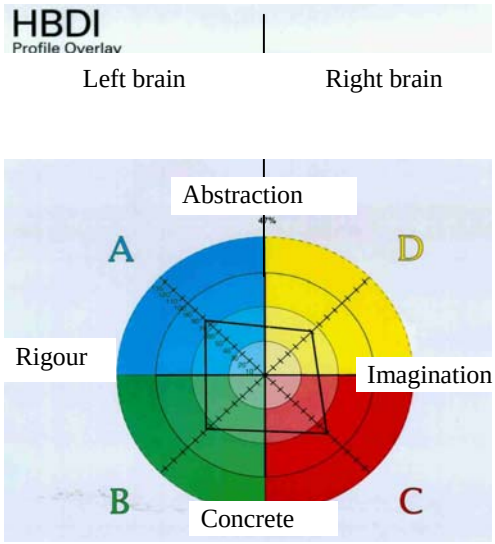

Fig.1: example of profile

2.1.2 How to use the Hermann diagram

Hermann model has multiple possible applications: better self-knowledge, job request, coaching, assistance to the constitution of teams or adequate working groups according to the problems to be treated, improvement of the communication inter individual and group in a community…

2.1.3 Pedagogical application

But we can also use the results to improve the teaching approach. Indeed, if one superimposes the traditional diagrams of teaching scientists (course, training, practical lesson) on the diagram, one realises that the process of training requests only the left brain, that the approach is downward (theory towards the practice or practical towards the theory) (Cf figure 2).

Consequently, the motivation, the emotional aspect, the need to know with what is useful received teaching, is completely ignored. This negligence partly results in reinforcing the incomprehension of the pupils, their lack of interest and their absenteeism.

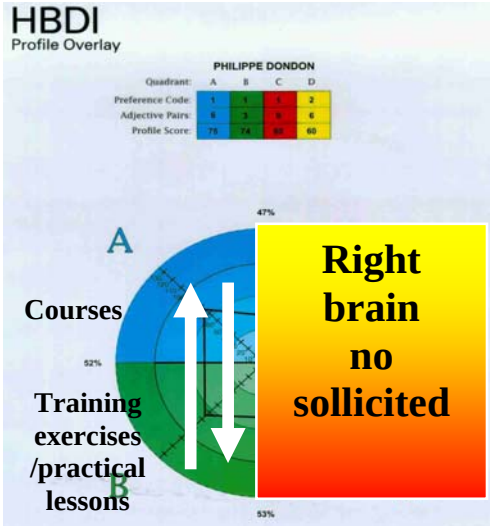

Fig.2: traditional pedagogy

2.1.4 The private internal corporations training seminars example …

By analysing the content of many seminars held in private companies (internal formation or others), we observe that the success in term of effectiveness (or perception of the delivered message) depends on the approach of the problem; The successful seminars have all the joint diagram of unfolding below: They begin with a making of contact, mutual and reciprocal knowledge of the group (quadrant C). Then, they request the quadrant D making the participants conscious of their individual interest they have to follow this seminar.

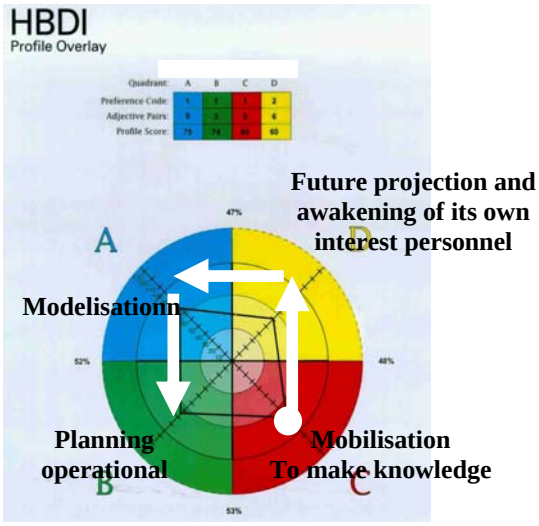

Fig. 3 : The keys of the success

Once charged interest, the motivation of the group is acquired. One thus undertakes the theorisation or the modelling of the problem to treat (quadrant A). At the end of the seminar, one decides on a calendar of application, priorities and miles stones, practical tools required (quadrant B). With this final step, all the quadrants were requested in an adequate order to improve adhesion of the listeners and their motivation for the task or teaching suggested. That makes it possible to maximise the chances of success of an operation whatever it is.

3. Herman approach applied to a teaching example

3. 1 Teaching strategy

We first choose to experiment the Herman approach on a small field of the whole electronic program. The idea was to test the student's reaction in front of this new strategy.

We suggested to the students to discover what embedded system and multi sensors are, through an integrated project design of a small robot.

As this subject is quite difficult to understand, we thought about a funny but serious application to make the connection between theoretical courses and practical lesson easily as possible.

The support of this experience is the small walking robot "toddler" from parallax company inc[3].

3. 2 Short description of the robot

The toddler is a small walking robot around 25 cm height. Two servo-motors move the legs of the robot for a rustically motion. When moving, the toddler looks like a bear rolling from one leg to the other one.

It can walk straight away or back. It also turns to the left or right.

Energy comes from a reusable battery cells located on top of the robot for an optimum mechanical equilibrium.

The original Basic stamp board has been replaced by a custom board based on a micro controller PIC 16C873 for teaching facilities. It allows

programming the controller in assembler or C languages.
A set of sensors can be used to help the toddler during a walk.
A view of the robot is given in figure 4.

Figure 4 : Toddler view

Moreover, the use of this kind of robot for pedagogical purposes allows the students to explore different basic concepts of modern electronic: here, “embedded system”, ”real time programming”, "multi-sensors fusion".
However, some custom adaptation have been done to customise the robot and to make it a total illustration of theses basic concepts.

3. 3 Teaching strategy

The project is organised as the other classical project: that is, group of twelve students, one afternoon each week during one semester.
According to the 2.1.4 paragraph, the lesson started by making contact, mutual and reciprocal knowledge of the student’s group and teachers. A short and funny demonstration is done to show the ability of the robot (quadrant C). By this first step, we establish a confident relationship between us which is the first key of project success.
Then, comes the most important step of the approach: each student must discover himself, his own personal interest to a self implication in the group’s project (Quadrant D). At this crucial moment, everyone forget the scientific and electronic goals and the teacher organises a short “brainstorming session”. A few questions are asked to the students. Free and spontaneous answers are a guarantee to discover the motivation of each student. A feed back loop is done until each student is fully convinced of his deep motivation. Whatever are the reasons of the student’s interest (we discover a wide range of interest such as electronic passion, software fanatics, creativity development, artistic aspects, domestic uses, commercial business…), the most important is that every student is finding a personal goal to be an actor (and not spectator) in the project design. A written summary of the brainstorming session is given to all students at the end of the day.

From these two main steps of the Hermann approach, depend the success or the chess of the teaching process.
After this preparation, the receptivity for theoretical courses is normally maximized. Students are now ready for the A Quadrant solicitation: Through some classical and basic courses, they learn during one month all what is necessary to manage the robot project.
In order to preserve the freedom and motivation of the students, the project specifications (choice the movement strategy, choice of sensors used…) are defined by the students themselves inside a general framework given by the teacher.
For example, the sensors are chosen among a set of available sensors such as mechanical bumpers (fig 5),

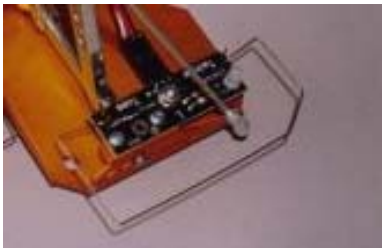

Fig 5 : bumpers

infrared sensors PNA4602M , infrared telemeter Sharp GPD 2xx, light sensor VT 900, electronic compass board CMP03, memsic 2125 tilt sensor, and so on.
The chosen movement strategy must be quite simple in order to make the debugging easy. It can be for example, a walk on a table in circle, with edge detection and a stop in case of edge or obstacle detection. In that way, infrared emitter/receiver cells are mounted as indicated in figure 6.

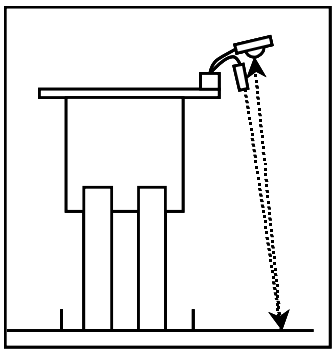

Fig 6: example of infrared floor detection

When specification are fully defined, the teaching process goes on by solicitation of quadrant B.(practical work).
According to brainstorming session results, the project is scheduled and partitioned. Thus, each student is involved to global project in respect with his personal goal.
We find here classical tasks in a project such as :

- Bibliography research,
- Characterisation of the different mechanical parts or the robot,
- Characterisation of the chosen sensors (figure 7 shows an example of obstacle detection timing diagram; upper trace emitted pulse train 38 kHz, bottom trace sensor output changes : low level indicates an obstacle detection)

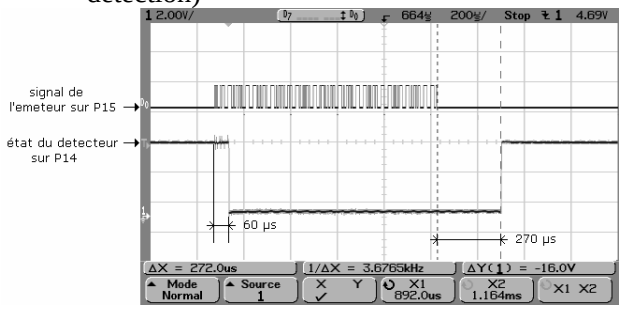

Fig 7 : PNA4602M infrared sensor response :

- Determination of the number of interfaces with the processor board,
- Choice of the microcontroller,
- Board electronic design,
- Motor control electronic,
- C and assembler software generation,
- Performance measurement (power consumption, velocity, obstacle detection ability…)
- Technical final report edition

At the end of the project, a short time is dedicated to a debriefing, in order to get the feeling and feed back of the students (back to C quadrant). Then, the Herman process is correctly achieved.

4. Results

Even if it is always difficult to "measure" the impact of a teaching strategy, this one seems to be more attractive and efficient than before, looking at the results of the "debriefing report": The last one shows that the satisfaction rate raised from 45% up to 65%. There is particularly a good feed back for the brainstorming session. The students appreciate also the funny aspect of the project. At least, they point out the system approach which allows mixing their different acquired technical knowledge. The same kind of results has been obtained by ours colleagues from INPT Toulouse [4] after a similar experience.

5. Conclusion

We showed in this paper that the traditional teaching methods do not match anymore with the actual pedagogical needs. As we can not change the student, we must adapt our pedagogical approach to them: Including human and psychological aspects seems to be a good way (among others) to improve the efficiency and the quality of our teaching. Through a serious, open and funny robot design project, we showed that it was possible to restore motivation and curiosity, to increase the work capacity of our students. We hope to extend this approach to other scientific fields studied in our school.

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