E-LEARNING ACTIVITIES DESIGN AND INDIVIDUAL LEARNING STYLES
Case Study

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Abstract: With this paper the authors aim to explore the importance of e-learning activities and materials' design towards attaining learning and development objectives. This work rests on the belief that activities' design must be thought according to different learning styles, and is based on a case study from a hands-on-project – "Think Industry" (TIP) focused on experiencing. TIP is running since 1995 and it has encompassed more than 7600 youngsters with ages between 13 and 17 years old and enrolled on the formal teaching system. The main objective for the TIP is to develop a positive vision of industry and of employment opportunities and technical careers in the industrial sector. TIP activities are clustered in three main categories: (1) awareness; (2) experiencing; and (3) complementary support actions. The authors will focus on one e-learning experiencing activity' design and implementation: "This is an Idea!" (TiaI!), an web based game designed with the objective of fostering entrepreneurial spirit and creative in a sustainable and global way. Pedagogy, technology use and global impact were the main drivers for the development of the e-learning game TiaI!. The game is used according to different styles of learning: (1) reading; (2) seeing; (3) hearing; (4) watching; (5) doing – experiential learning; (6) learning by teaching/selling. Some reflection for the future, based on this e-learning experiencing game are: (1) people have basic styles of learning, usually tent to prefer one. So if we provide different styles we can strive higher mastery; (2) Blending more than one approach improves retention and proficiency; (3) e-learning lacks socialization, but with this program it is a complement to one global understanding of pré-determined issue (e.g. renewable energies, fuel cell energy, new products design, global impact of technology use, development of green technologies); (4) Feedback and global contextualization are mentioned to be important issues for the development of a "new" or "renewed" conscienceless for the globe; (5) Youngsters approve the use of different means for the attainment of the same objective; (6) The design stage and the learning point are crucial to success; (7) Personal values need to be spoken and challenged in an entrepreneurial fashion to promote awareness.

1 THE ENTREPRENEURIAL LEGACY FOR E-LEARNING AND INDIVIDUAL LEARNING STYLES

Some researchers argue that an increasing number of Western economies have transformed into arenas where information, services and knowledge have become the primary value creators, e.g. Castells (2000), Dobers and Stranngard (2005).
If so, information, services and knowledge are powerful and strategic weapons towards attitudes, values and behavioural change. These aspects must be taken in account when designing learning and development programs (namely e-learning and b-learning) for different target audiences.

"New" forms of learning closely related with lifelong learning and personal development emerge and develop more and more each day (e.g. e-learning, m-learning). E-learning, b-learning, virtual learning environments, wikis, Internet based games, among many other forms carry the legacy from their ancestors, distance learning, mediated communication and computer based learning. These are well established practices in business and leisure areas, in private and public institutions worldwide.
E-learning is characterized by a blended mixture of delivery trough technology and some change in the individual/grupal learning stage. For designing the program it is important to reflect on "How do people

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learn?" on virtual and on real environments. So…. We ask: How do people learn? Much research as been done on learning styles, and there is no doubt that we can apply those principles to e-learning and b-learning contents and course design. People learn in different ways, but it seems that there are three primary ways to learn (Bersin, 2004):

- **Visual Learners**: Approximately 50 to 70 percent of the population. People on this cluster relate most effectively to written information, diagrams, images and pictures. Visual learners like to take notes, write on the whiteboard, create and view power point slides with graphics.
- **Auditory Learners**: Approximately 20 to 40 percent of the population. The best way to learn is hearing. These people like to listen to lectures and take notes later.
- **Kinaesthetic Learners**: approximately 5 to 20 percent of the population. Learn best through touching and doing things. These people learn by imitating, trying, holding and feeling things.

As some researchers have argued and defended previously (e.g. Fernandes and Rocha, 2006a) people learn best by doing, the often called "experiential learning". This was the principle used on all the activities underlying the TIP' project, the case study presented in this paper.

Table 1: Six models of learning.

	Approach	Techniques used (examples)
Higher level of Mastery ↑	6. Teaching	Mentoring, manager assistance, on-line coaching
	5. Doing	Simulations, on-the-job exercises, labs, web interactivities, scenarios
	4. Watching	Demonstrations, instructors, video, replays, animations, scenarios
	3. Hearing	Lectures, discussions, audios, webinars
	2. Seeing	Graphics, images, videos
Low levels of Mastery	1. Reading	Web pages, books, documents

Adapted from Bersin (2004, p. 35)

According to Bersin (2004) there are mainly six modes of learning according to the mastery you want to obtain at the end of the program: reading, seeing, hearing, watching, doing, and teaching. "Mastery" is a combination of proficiency and retention. Proficiency measures the ability for learners to perform a task accurately and retention the ability for the learner to remember and apply the task to many different situations.

There are many questions on e-learning that are still open, and with different answers according to the contextual, personal and organizational variables. Doing so, goes considerable way towards addressing these issues, delivery, maintenance, cost, content quality, target audience in a single way. But, we can also ask if the e-learning field is moving fast enough to warrant the attention lavished on the subject? Every organization must take the best out of its own resources, creativity and different ways for using the same tools striving renewed answers approaches to challenges that emerge each day. There is the need to design new business models based on the use of several tools available on the organizations, and according to the target audience defined.
In this paper the authors explore one particular activity "This is an Idea!" (TiaI!) enclosured in one hands-on project "Think Industry Project" (TIP). TIP merges new ways of learning (e-learning) and traditional learning.

2 CASE STUDY: TIP "THIS IS AN IDEA!"

Hands-on programs have been originally proposed as means to increase student achievement (in science education), and in the authors approach, hands-on projects such a TIP, also intent to promote general conscience on several issues, and be the basis for a differentiation for career interests. There are several theoretical rationales for hands-on programs that are explored by Fernandes and Rocha (2006) and applied on TIP activities. Scientific knowledge for reality as youngsters know it is the main work base for the several TIP' activities. Researchers identify mainly two broad domains of scientific knowledge: (1) content knowledge, and (2) process skills knowledge (Glynn & Duit, 1995; Lawson, 1995), the authors' extent it to a third one, (3) Real world knowledge. Content knowledge, also known as declarative knowledge includes the real "contents" that students are supposed to know, remember and understand, such as theories, principles, facts, theorems, laws, etc.. Process skills or procedural knowledge are the techniques and approaches to solving a problem, such as observation, measurement, hypothesis formulation and testing, among many others. Real world awareness it's the link of both of the former to real life contexts namely industry and possible impacts. It allows youngsters to give a meaning to their knowledge, promoting the learning and development of a global

awareness for the impact of different knowledge and its real application, even that this knowledge is acquired on-learning through a game or any other activity. The authors defend that the conjunction of the three complementary issues is necessary for the e-learning activities' design in a way that students can fully understand scientific knowledge and develop capabilities to apply it in real everyday life settings, namely the industry, never forgetting the global impact of each and every action.

2.1 TIP Characteristics

TIP is a hands-on program that encompasses youngsters with ages from 13 to 17 years old. The Technological Centre for the Metal Working Industry (CATIM) has the project running since 1995 (Rocha, 1998) and since then, more than 7600 youngsters were evolved in it just in this Technological Centre.

TIP has several stakeholders: general citizen, parents, youngsters, Technological Centres Network, Universities, Polytechnics and Research Institutes, Industry and Professional bodies, Education and Training Providers, National and local Government, Government Agencies.

The main objectives for TIP are to develop a positive vision of the industry and of employment opportunities and technical careers in the industrial sector towards a sustainable and active citizenship. In table 2 we present the main problem dimensions, specific targets and general objectives.

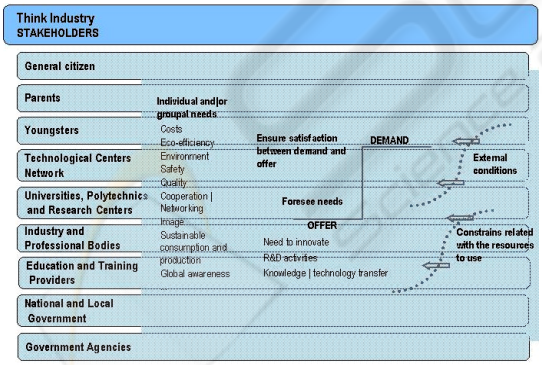

Figure 1: TIP stakeholders.

TIP's activities can be clustered into: (1) Technology laboratories; (2) Simulation games; (3) Field trips to industrial enterprises; (4) Visits and trips to events; (5) Thematic seminars; (6) Sessions held up at schools; and (7) TIP in the mass media. The activities developed under the TIP scope, generally tent to promote the understanding of different settings of the industrial value-chain, e.g. "simulation games" that represent management actions and functions, and "technology laboratories" that correspond to the manipulation of equipments related to the industrial activity and the underneath technologies applied in several industrial processes such as robotics, hydraulics, haptical devices, energy consumption, environment, mechanics, milling, lathering, etc..

Table 2: TIP' problem dimensions and objectives.

Main Problem Dimensions	Specific Targets	
Traditional image for the industry	* Develop a positive vision of the industry * To link industry with positive values and attractive careers	**To develop a positive vision of the industry and of employment opportunities and technical careers in the industrial sector**
Withdraw between youngsters in school ages and industrial activities and careers	* To make youngsters and industry closer (and vice-versa) * Evolve youngsters and industry in mutual approximation processes	
Training choices and market integration heavily influenced by commerce and services	* Make youngsters aware of industrial careers in short term * Motivate youngsters to carry on their studies on technological areas	

TIP is also designed to show youngsters new ways of learning and working, e.g. using e-learning and Communities of Practice (Fernandes & Rocha, 2006b, 2006c; Rocha & Fernandes, 2006).

2.2 Design and Learning Styles

2.2.1 Reading

Reading is the easiest way to "teach", and it consists in giving people things to read. Most material for e-learning encompasses reading material; there might be some exceptions like game learning or intuitive learning. When designed effectively reading is very effective for visual learners. In e-learning or in web environments reading is less valuable because people will not and cannot read long manuscripts on the web. Especially when our target audience are youngsters with such diverse activities, and are comprised in the majority of the population, are not visual learners. In the authors' perspective, in e-learning settings, reading is a source of referenced material, not learning. And it must always be complemented with an all kind of diverse elements

(in the clusters for seeing, hearing, watching and doing).

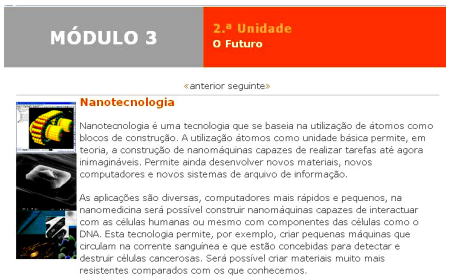

Figure 2: Print screen from the e-learning materials (Module 3 – Unity 2 – Nanotechnology).

2.2.2 Seeing

If we follow the hierarchy, the next step is "seeing". It encompasses diagrams, photos, images, etc. As we know and have experienced, visual images add tremendous "new" conceptual understanding to known or unknown settings. In the web we have extra-resources comparing to books or static material, such as animation, interactive tools, push buttons, knobs, slider bars, drag and drop applications, among many others.

Figure 3: Examples of used images on the e-learning materials.

There are some choices to be done relating to the "seeing" point: colours, pictures, which diagrams to animate, how to make synopses, the use of several resources (games, exercises, push buttons, knobs, slider bars, drag and drop applications).
We have chosen the "orange" colour for the main screens because is the colour for TIP is "hot", and it's a colour associated with youth. It had to be a colour according to the target public and that could motivate youngsters to read, see and learn in on-line environments (see figure 1). The contents encompass an interactive game – Pulltex for simulating Industrial settings (see figure 4). This game was thought according to the same premises.

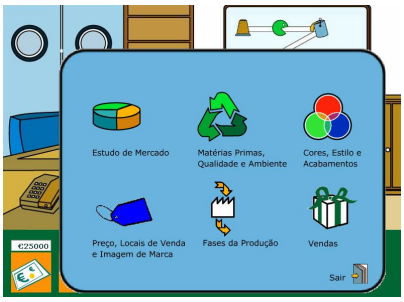

Figure 4: Pulltex game.

2.2.3 Hearing and Watching

In these clusters we have techniques related with sound, motion, and demonstrations. In our particular case we always add a scenario when there is an activity (e.g. Pulltex game, see figure 4). In this stage youngsters can read, see, hear and watch.
One improvement action to be taken in the contents is adding a button that allows youngsters to choose either they want to listen to a narrator or not when reading materials. This improvement adds authority to youngsters in the learning mix, improving interest, motivation and retention.

2.2.4 Doing – Experiential Learning

Research shows that the highest level of mastery comes from experiential learning: learning by doing. For example ask a call centre agent to answer a live call. In our case youngsters do the activities in their schools and then come to the technological centres to do it with other resources (e.g. machinery, materials). The e-learning materials provide the experience in an on-line environment – simulation (e.g. Pulltex game).
The final result from this doing activities is the participation in National and International Entrepreneurship contexts.

2.2.5 Learning by Teaching/Selling

By far the most valuable way to master a subject is to teach it. We apply this approach in TIP too. There is an all set of activities that complement the TiAI! Learning objectives, e-learning activities, industrial field trips, national and international contests, brainstorming, experiencing in the laboratory. Each team has to "sell" its own idea, they can appeal to several arguments (e.g. market studies, quality, environment, ecological impact, costs, designs, supply chain management).

3 ANALYSES AND DISCUSSION OF TIAI DEVELOPMENT

The TiaI activities are several, varying from laboratory sessions, industrial visits, to e-learning, simulations. The e-learning is part of a mix so that TiaI Learning and Development objectives can be meet.

The e-learning developing team took in account several aspects when working the contents. The aspects were clustered into 3 main categories: (1) Pedagogy; (2) Technology and (3) Global impact. There was also the general belief that e-learning is enormously diverse and dependent of the context whilst not always cognisant of the consequences (Massy, 2002).

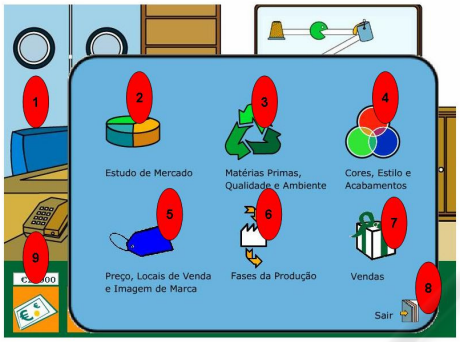

Figure 5: Nine aspect to explore in the Pulltex game.

Taking in account the pulltex game (one of TiaI's activities) one e-learning activity, it were taken in the 9 points shown in figure 5:

1. There is always a scenario for the game to take place (as real as possible). In this case we have an office. There are tasks that are done on the plant and others outside. This way generalization and knowledge application to other settings is easier to youngsters.
2. Global conscience is strived by benchmarking practices on the same game business areas. For example by looking at the market, dividing the target groups, defending the options to take.
3. Questions like Environment, Quality, And Global Impact are points that youngsters have to take in account for going through the different phases of the game.
4. Generalizing knowledge is the 4th item to work with. Youngsters get in touch with effective design practises and get to apply it on their games.
5. Price, brand, distribution channel are also points to work with when designing the activities.
6. The supply chain management and all its implications is not a forgotten issue. Global impact is thought of also in this point.

The systemic theories for organizational management are striven in this game. Youngsters can know see how one decision, for example the choice of one material to build an object can have an impact on several areas, environment, people, consumption patterns…With this game youngsters learn by doing in an on-line environment and in a second phase they do it presentially and with other youngsters.

Previous results on e-learning programs' evaluations were also used. The main complaints from users were information overload, difficulties accessing the web, conflicting technologies and lurking.

So the development team had to get to one final product were the:

- Information presented was useful and directly related with the topic;
- Superfluous or complementary information should be presented in accessory spaces;
- e-learning contents had to "run" in different applications and with different settings;
- Contents motivate people to participate and learn;
- Contents were adapted to the target audience;
- Contents had all the information presented according to different learning styles and approaches.

4 CONCLUSIONS

Programs for learning and development of youngsters (and all others ages) have to be thought in a structured way, so that broad objectives can be meet. There are several strategies and from research and practice the authors defend that the conjunction of content knowledge, process skills knowledge and real life awareness must be taken in account when designing e-learning materials, so that the learning and development objectives can be meet. Different learning styles have to be taken in account when designing e-learning materials to promote learning and development, and to promote behavioural change, and adoption of new or renewed behaviours.

Some reflections for the future, based on this e-learning experiencing game are:

(1) People have basic styles of learning, usually tent to prefer one. So if we provide different styles we can strive higher mastery;
(2) Blending more than one approach improves retention and proficiency;
(3) e-learning lacks socialization, but with this program it is a complement to one global understanding of pré-determined issue (e.g. renewable energies, fuel cell energy, new products design, global impact of technology use, development of green technologies);
(4) Feedback and global contextualization are mentioned to be important issues for the development of a "new" or "renewed" conscienceless for the globe;
(5) Youngsters approve the use of different means for the attainment of the same objective;
(6) The design stage and the learning point are crucial to success;
(7) Personal values need to be spoken and challenged in an entrepreneurial fashion to promote awareness.

It appears that the secret to successful learning (e-learning and probably all learning) is surprised and reinforced at the designs stage previous to the learning points. The values of both need to be spoken to and challenged in an entrepreneurial fashion by being novel, positive and with an element of risk. As defended by Al Gore in several public seminars, the word for crises in Chinese is the conjunction of danger and opportunity. The balance between both is the critical point for learning, development and innovation. So, industry must make the best of all means for developing new business models and getting a qualified workforce. E-learning gained with "traditional" pedagogy and owns new tools for maximizing learning and development, in this setting e-learning activities' design is central,

5 REFLECTIONS AND IMPLICATIONS FOR FUTURE WORK

The strategies suggested by different theorists' tent to overlap and often advocate a judicious selection of approaches rather than an exclusive focus on just one. According to Coffield et al. (2004), the critiques to learning styles can be divided into two main champs. First, there are those who accept the basic assumptions of the discipline (e.g. the positivist methodology and the individualistic approach), but who nevertheless claim that certain models or certain features within a particular model do not meet the criteria of that discipline. A second group of critics, however, adopts an altogether more oppositional stand: it does not accept the basic premises on which these bodies of research, its theories, findings and implications for teaching and training have been built. The opponents are basically the ones on the quantitative approach side and on the other hand the qualitative approach.

According to Dewey (1916, 170), pedagogy is often dismissed as futile because: "Nothing has brought pedagogical theory into greater dispute than the belief that it is identified with handing out to teachers recipes and models to be followed in teaching". In this century that has passed since these stirring words were written, it is surprising how the concept of pedagogy has remained relatively unexplored and untheorised. Literature review suggests persistent problems in learning styles theories, such as: (a) theoretical incoherence and conceptual confusion; (b) labelling as a mean to classify and intervene; (c) variables quality and reliability; (d) psychometric weakness; (e) unwarranted faith placed in simple inventories; (f) lack of communication between different research perspectives on pedagogy and we could add (g) lack of application to training and development fields, (h) to centred on academic outputs.

But we can not neglect the positive implications of applying to practice pedagogy findings, in spit of all the critiques surrounding the field. And we know that the primary professional responsibility of training professionals is to maximise learning and development opportunities for their trainees. The changes in the training resources available, for example concerning technology, opens new doors to pedagogy implications in the field. Training programs supported by e-learning or m-learning are mostly unexplored for theirs real practical implications. A number of questions that we would like to research could be address as follow:

- What are the implications of pedagogy for designing e-learning and m-learning contents?
- What impacts are learning styles having on on-line training methods?
- Do instructional designers know how to monitor and improve learning and cognition on others' learning with the developed materials?
- How far do e-learning contents design affect trainees' and trainers' responses to knowledge about their learning styles?

Only research allied to practice can answer these questions. No better way of testing, than making it happen in training.

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