Computer Based Intelligent Learning Environments (CBILE) specific to the high level safety training

Mihalca Rodica, Ută Ileana Adina, Kovacs Stefan

Abstract: ***Safety is a very important component for every enterprise. Safety could offer very important gains if it is implemented and maintained efficiently inside the enterprise. To implement safety there is the imperious need to have well trained teams. In performing safety training we found that Computer Based Safety Training (CBST) [1] is the most satisfactory one, taking into account the specific training problems of the safety domain. In our paper we present some aspects regarding the optimization of CBST into Computer Based Intelligent Learning Environments (CBILE) taylores specifically to obtain maximum results [2]. A prototype of CBILE was developed centered on a hard core training nucleus surrounded by safety rich learning, intelligent environments.***

Keywords: Computer, learning, safety, training

GENERAL ASPECTS

Safety is a deed for every enterprise. Every year, occupational accidents occurred in Romania caused by non- efficient safety are making over 6000 casualties. The corresponding loss is over 10 billion Euros every year. Safety depends greatly on two aspects: a proper safety training and efficient safety device.

In order to assure safety at the workplace there must be efficient trained workers. Safety training is a very specific one. Some of the most important aspects are presented below:

- Safety training must be problem-oriented [3]; general safety training is just of theoretical use;
- Safety training must be case-oriented.
- Safety training must be a hands-on approach.
- Safety training must be based on cognition rather than memorization.

We have performed a multi-disciplinary research in order to be able to improve and efficiencies correspondingly our safety training process. This research was conducted with the support of inner research programmers and outer excellence networks founded by the European Union – like the S2S (Safety to Safety) network. Our research included universities (the Academy of Economic Sciences) , research institutes (The National Research and Development Institute for Labor Protection, the Pedagogical Institute) and enterprises.

In our research we found that the best safety training is CBST and that we could greatly improve the efficiency of this training using an expert approach based on specific knowledge structures called eduknowledge. Also we found that a separation between core learning structures and intelligent learning environment could be the winning solution.

Some of the most relevant aspects of this research are presented below.

TYPES OF LEARNING AND THEIR MATCH WITH SAFETY TRAINING SPECIFICS

Safety assurance is a very practic discipline, based however on multi-disciplinary theoretical foundations. From the general types of learning we were focused on the following specific types- best suited for the safety management domain:

- Concepts [4] (Discrimination): Concept learning encompasses learning how to discriminate and categorize things (with critical attributes). It also involves recall of instances [5], integration of new examples and sub-categorization.
- Reasoning (Inference, Deduction): Reasoning encompasses all thinking activities that involve making or testing inferences [6]. This includes inductive reasoning [7] (i.e., concept formation) and deductive reasoning (i.e., logical

argument). Reasoning is also closely related to problem-solving and creative behaviors.

- Procedure Learning: Procedures refer to being able to solve a certain task by applying a procedure [8]. Once a procedure is mastered its excused usually does not take much effort (e.g. ftp a file). Cognitive theories like Act or Soar are interested in this, because procedures are important in diminishing cognitive load. Best Practice Procedures are specific to safety learning.
- Problem-Solving: information processing paradigm for the study of problem-solving and the concepts of "means-ends-analysis" and "problem space".

Figure 1 shows how these theories are used in our research.

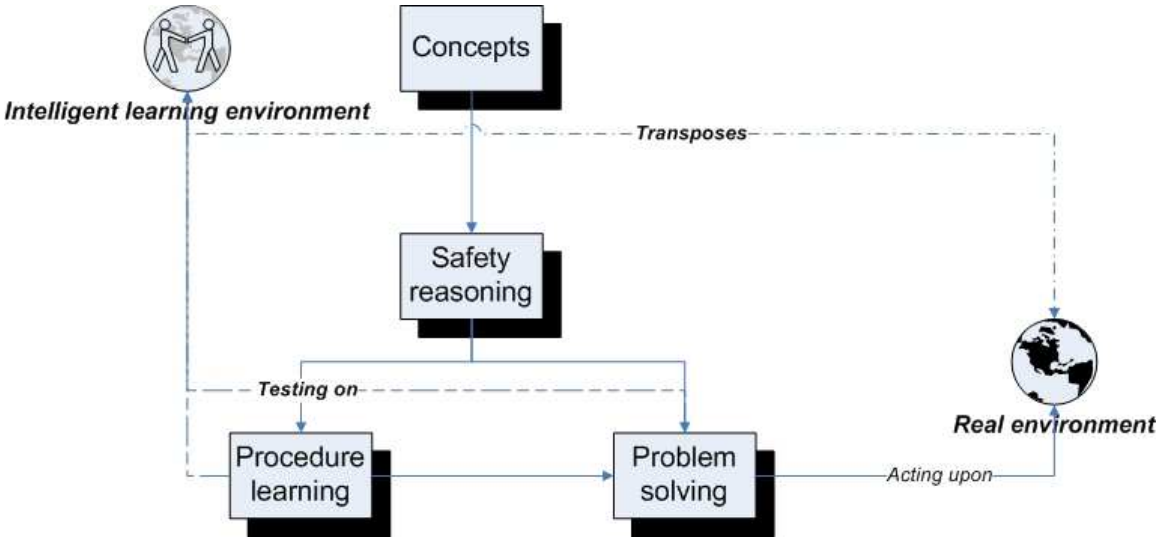

Figure 1 Used learning theories and their combination

From the conceptual point of view we found that the paradigm stating that we could differentiate in the training processes between sources- facilitators (or gates) and users is the most efficient in order to develop specific models for :

- Safety knowledge sources;
- Safety knowledge facilitators (gates);
- Safety knowledge receptors;

A theory is just a theory. In order to be efficient it must be expressed into an obiectual structure, based on specificity and with the possibility to be quantified.

Starting from these theories we found an optimal sequence of major strategic bricks. This sequence is presented below

1. an elaborative and intelligent environment [9]
2. learning prerequisite environmental sequences
3. summarizers
4. core structures
5. analogies
6. cognitive strategy activators
7. a learner control format

This sequence must be centered upon the learner and its problems, as shown in the next paragraph.

THE LEARNER AND ITS PARADIGMS

User paradigms [10] are based on the following metaphors:

- The transmission metaphor [11]:Focuses on competencies and knowledge to be acquired by the student
- The learner-centered metaphor[12]:Focus on learners' needs, attitudes, cognitive processes
- The participation metaphor[13]:Focuses on the whole teaching and learning activity [14]

In our research, learners were motivated to acquire new knowledge while "immersed" in some topic through problem solving activities. This approach proves the most efficient one.

"Microworlds" [15] were specially build in order to immerse the learner in specific aspects of the problem space. These microworlds were designed as specific intelligent learning environments suited for the learning of a given knowledge.

The next figure shows learner and its paradigms.

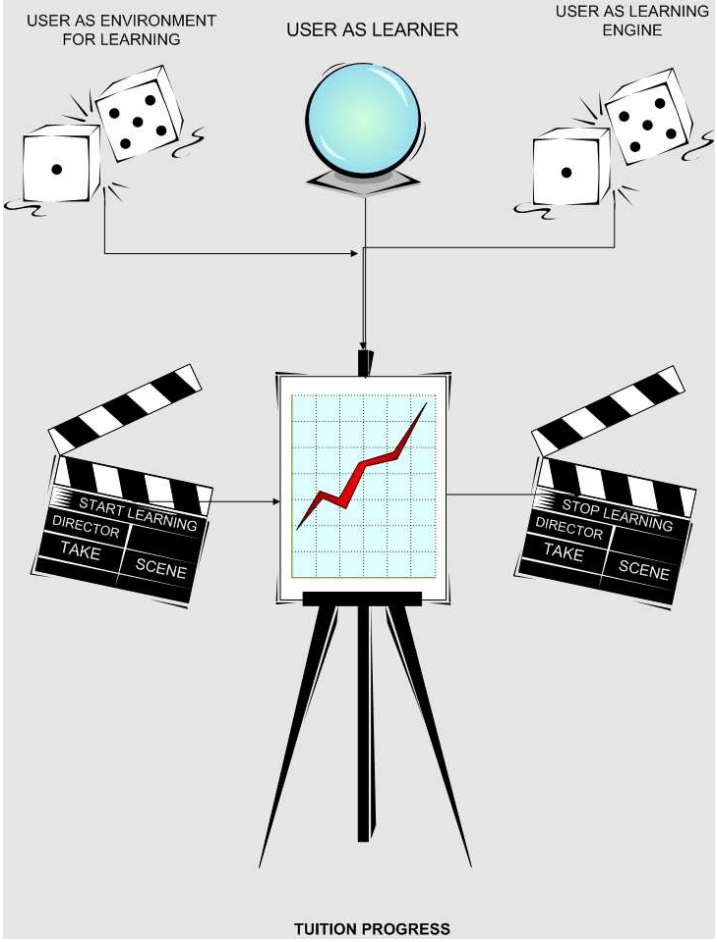

Figure 2 Learner and its paradigms

OBTAINED RESULTS

Based on the aspects shown before we have developed a prototype designed for advanced safety learning using CBT.

The set-up of the training system involves the following components:

- A hard core learning nucleus- which has the essence (need to know) safety knowledge; this hard core nucleus serves also as the control homeostatic mechanism [16];

- An intelligent safety learning environment- this environment has some interesting properties:
    - Is intelligent- so as to be focused on the learner and to help the learner not just navigate through the learning topics but also interact in order to build himself a reasoning mechanism; this reasoning mechanism [17] would be of utmost importance in safety assurance as the only way to distinguish in real time, at the work place, between right and wrong; this decision could be decisive in life and health preservation;
    - Is distributed - the distributed characteristic helped greatly in the development of an efficient tuition process; actually, the learner is surrounded [18] by the intelligent learning environment, acting in every moment in which he/she performs the learning process with some part of the learning environment;
    - Is task oriented [19]; the intelligent agents that are the bricks of the safety learning environment are each one single task oriented; by composing them in the intelligent learning environment every attitude needed in safety assurance is purchased through specific designated agents [20];
    - Is reusable- the modular development of the components of the intelligent environment allows the reusable feature of the environment- actually, it was used especially in process safety and also in transport safety maintenance;
- Rich meaning learning agents[21]- as shown before the safety tuition must be case oriented; the rich meaning learning agents actually are imprinting[22] the heuristic knowledge derived from the case examples into the learner through the rich meaning.

Actually, at the base of all these structures lies the eduknowledge. In the hard core learning nucleus the eduknowledge is fully developed and loaded. In the rich meaning learning agents [23] are loaded just the case components of the eduknowledge together with the corresponding learning procedures. In the intelligent environment is used just the frame of the eduknowledge in order to orient the learner and allow him to interact with the problem space [24].

A brief image of the structure is presented below.

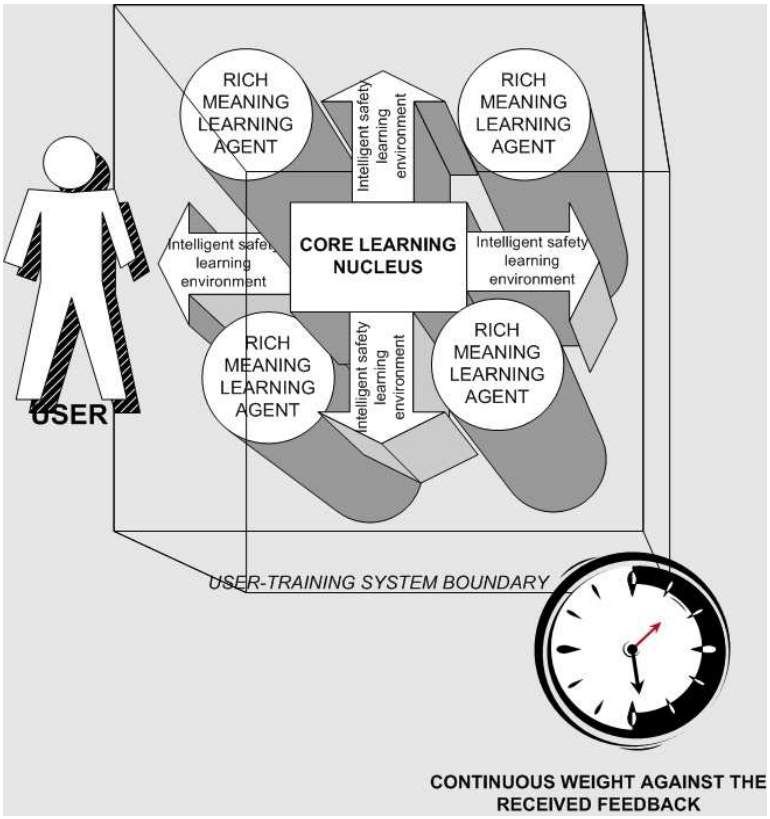

Figure 3 The learning mechanism

All the structures were implemented into a developed prototype using a combination of expert based tools and authoring systems. The connection between components is performed through topic maps and meta-data structures. The developed prototype is SCORM and AICC compliant.

A neural network supervisor was designed in the idea of being implemented as a future control system.

The study of user- training system boundary needs a more profound analysis. We have considered this boundary as the essential boundary in order to perform optimally the learned procedures and we have developed this boundary using the finite element approach applied to the learning processes.

CONCLUSIONS

The proposed approach improves the efficiency of the safety training process with up to 80%. This improvement is manifested in the elimination of specific risks and reduction of occupational incidents and accidents. It must be expressed that the statistics show that up to 75% of the occupational accidents are caused by the human operator. By them, about 80% are training dependent.

Our prototype was applied in pilot centers around the Romanian economy, mostly in the process industries area. Its development could be of great importance not just for the safety management but also for the efficient loss control inside the enterprise. Accidents are just the visible face of the iceberg. More economically significant are safety related loss occurring in every enterprise, even in the enterprises without occupational accidents. These areas could be also efficiently controlled by our training system.

The pre-requisites of its implementation are minimal. An average PC with multi-media facilities is sufficient in order to perform the tutorial process. Supplementary multi-media devices could be added in order to develop virtual safety worlds (VSW).

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ABOUT THE AUTHORS

MIHALCA Rodica, Professor PhD., Academy of Economic Studies, Economic Informatics Department, 15-17 Calea Dorobanților Street, Bucharest, Romania, +(4021)-319.19.01 / 336, 319, rmihalca@ase.ro, mihalca@b.astral.ro
UȚĂ Ileana Adina, Senior Lecturer, PhD., Academy of Economic Studies, Economic Informatics Department, 15-17 Calea Dorobanților Street, Bucharest, Romania, +(4021)-319.19.01 / 336, 319, adinauta@ie.ase.ro
KOVACS Stefan, PhD., National Institute of Research and Development on Occupational Safety, 15 Gral.Budisteanu Street, Bucharest, Romania, +(4021)-313.17.29 / 149, stefan_agk@yahoo.com