How designing a virtual environment for professional training from an activity framework? Dialog between ergonomists and computer scientists

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1. Introduction
This communication presents and discusses an approach of works’ analysis based on activity framework (Daniellou & Rabardel, 2005), elaborated to contribute to a design training process. This approach was developed within the context of a design project aiming to build a Virtual Environment for Professional Training (VEPT) for workers involved in the assembly of aircraft parts (ANR project named “Nikita”1). We tackled this issue from the double point of view of researchers in ergonomics and in computer sciences implied in this interdisciplinary project. This project aimed to build a “low cost” highly complex and open virtual environment for training very fine technical skills in aeronautics. In the line of previous works (Barot et al, 2013), it sought to elaborate a balance between 1) the freedom of action; 2) the control to provide customized learning scenarios; 3) the adaptability to enable reusability, reconfigurability, scalability and variability of situations; 4) the consistency to allow explicability and representativeness of simulated situations. This new artefact had to be designed in order to become a real training instrument for trainers as well as a learning instrument for the trainees (Rabardel, 2002). A work analysis was conducted in order to create benchmarks for the design of the virtual environment and to support its development. Following Daniellou (1996), work analysis was considered here as the overall approach, where activity analysis is inserted in an analysis of economic, technical and social factors that the operator is facing. With this in mind, we have developed an approach involving different stakeholders: the headmaster, trainers, trainees, the engineer of the prevention risks department, the ergonomist of the production site, production operators, team leaders and the chief of production line. All involved at different times of the present work analysis approach and with varied levels of involvement.

The project ownership had two levels of stakeholders such as a project, the ANR and the industrial partners, the project execution - supporting the feasibility of the project – consisted of three research teams and a 3D graphics company. Each was responsible for and guaranteed a technical part of the future VEPT. As usual, there was a “low” presence of the project ownership in the project to the benefit of the execution project. The “risk” was then that the project was “only” oriented by the technology development: the VEPT could be considered as a technological artifact (and not its uses). In this context, the works analysis approach implemented was intended as an interface between the ownership and execution of the project.

2. Method
This communication will present in detail the work analysis approach conducted in the two first years of the project: a three steps work analysis oriented by 1) « objectives and scope of the project », 2) the « existing works » and 3) the « co-analysis with trainers ». The methodological framework will also be exposed: 8 observation-days in production and training situations, 20 interviews with trainees and 2 confrontation

interviews with trainers. This data were used to model work activities and guided the design project of the VEPT.

3. Results
Results will be not on the main results of the VEPT evaluation. It will be on the design process conducted in a multidisciplinary research project. Three types of results will be presented which recall the investigations realized during the process of design and the evolution of the project.

- On design process: mutual learning and methods for adjustments between designers and operators. What kind of work the joining and assembly work-activity looks like and what are professional gestures in these situations? Who will be the final user(s)? Which empirical material the ergonomics team can product? How it is suitable with computer scientists approach? Moreover, these issues changed the project management and the initial goals of the design project;

- On the artifact: The potential and the limits of « low cost » VEPT to train to a very complex work activity with very fine-grained sensory-motors skills and for tasks that take several days. How could it be possible to represent haptics, auditory and visual information (e.g. the force feedback of the drill, the roughness in the surface of the metal parts, the noise of the riveting gun)? How it is possible to reconstitute the specificities of workstations and postural constraints (e.g. the concave and rough aspect of the ground, the work in the kneeling or lying position)? How to take into account collective dimension of the work but also the organizational level (e.g. working in pair on the same task or sharing small space with other colleagues; problems of the supply of spare parts or uncertainties of the workforce in teams)?

- Scientific object: Evolutions of the main goals of the project and the identification of the limits of “low cost” EVPT had consequences on scenarios’ choice. Scenarios’ design has been built to train the cognitive dimension and the conceptualization of the joining and assembly work activity in the production situations.

4. Discussion
Contributions and difficulties of this work analysis approach will be discussed from the double point of view of ergonomist and computer scientists implied in the project. Then, the paper will present the differences between this design management and usual approaches on HCI design centered on the user and tasks frameworks (Brough et al., 2007; Burkhardt, 2003). Finally, we will discuss this impact of a global design management oriented by a work analysis approach of field operators (Barcellini et al., 2015).

References