

Chapter 13

Training Design Oriented by Works Analysis

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Abstract This chapter presents an approach to training design oriented by a holistic real-world works analysis based on several works of research. This approach proposed to design training in order to make people able to deal with real-world work situations, rather than only to know and apply exogenous standards. Two main axes of progress in the design of vocational training are identified and could develop into guidelines in order to train people to deal with work situations. (1) The approach requires project management in order to use participatory methods, including end users (trainers and trainee) and integrate a works analysis. (2) The approach needs to move from classical teaching-learning methods to “active” methods, which often imply transformation of both the trainer and the trainee’s activity. Examples from previous research in training design are presented to illustrate the argument.

Keywords Real work situation • Vocational training • Participation

13.1 Introduction

We share the three conclusions made in the initial call concerning safety in industry (Foncsi 2015):

1. an isolation of safety from the other dimensions of work,
2. a disembodiment of work situations, and
3. the view that training is designed and implemented by stakeholders who are guided in particular by concepts of accountability and compliance with exogenous standards.

However, these three points do not apply only to the topic of safety. Systems of professionalization frequently focus on technical and regulatory contents, isolate

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some specific dimensions of work—such as safety—from all others, and are designed based on a frame of reference. Let us also note here that these frames of reference are often originally designed for reasons other than training, such as regulatory purposes for example. It seems, then, that the topic of the call questions the very purpose of professionalization systems.

From this perspective, the present contribution aims to present an approach to design formal courses of professionalization based on real-world work activities. It is based on two main principles that will be exposed here:

1. professionalization of workers is a living and dynamic process;
2. formal training courses must be designed that are oriented by the analysis of real-world work situations. This approach might go some way to answer the question posed in the call: *“Is professionalization a safety issue... or the other way around?”*. In this chapter, we will briefly outline some noteworthy points concerning professionalization and the theoretical background of the proposed approach.

We will then address several guidelines based on research in training design in high-risk domains.

13.2 Professionalization: A Long-Term Living and Dynamic Process

“Professionalization” could refer to the process by which a person acquires the acceptable competencies and qualifications recognized by a professional body, or more broadly by a professional institution. It is therefore an individual and a social process that creates a dividing line between qualified workers, unqualified workers, and amateurs and is thus related to a frame of reference of required competencies and a formal system of qualification.

In these terms, the individual process of professionalization refers, for the workers, to the development of their competencies during their career. “Professionalization” is then a living and dynamic process oriented by the development of the ability to cope with work situations. It should be viewed as an on-going, long-term process related to the career path rather than a piecemeal process. One challenge is therefore how to design formal training courses in order to efficiently support the professionalization of workers.

All kinds of learning and training situations could refer to “professionalization”. These include formal training systems as well as informal, on-the-job learning. Professionalization systems should aim to make individuals able to cope with the work situations with which they are confronted on a daily basis, in all of their complexity. Seen in this way, the challenge of vocational training systems would be to foster the development of vocational competencies that can be effective in work situations—that is, competencies that integrate the issues of production, safety and

quality, as well as health. In order to achieve this, the design of a formal professionalization system must be guided by real-world work situations. This refers to how one can transfer work situations to training situations, in order to support the development of skills, whilst ensuring that they also favour the transfer of these skills in future work situations. These dialectics invite us to think in terms of vocational training courses rather than in terms of mere sequences of training sessions that are decoupled from an inscription in people's vocational history. In the same way, it suggests a need to think about the continuity and breakthroughs between the learning potential of work situations and training situations, with the goal of promoting the articulation between the two.

Hence, the goal of professionalization systems becomes knowing how to construct the potential for development that lies in situations of training (Mayen 1999) and/or of work (Falzon 2014), in order to help individuals develop the skills that are sought after by the organization. And in the case of safety-related questions, it would be advisable to include the issues that are inherent to work situations without separating them from other dimensions: the tasks that are to be completed, the questions of performance, collective dimensions, health, etc.

13.3 An Activity-Based Approach to Design Vocational Training Situations

We therefore propose a holistic approach to the design and assessment of vocational training courses, stemming from the contribution of ergonomics (Falzon 2014) and vocational didactics (Pastré 2011), both of which refer to the concept of work activity (Daniellou and Rabardel 2005). This alternative approach is based on a set of principles regarding human activity and its conditions of elaboration (Daniellou and Rabardel 2005) that are very useful for designing situations that foster learning and the development of vocational competencies. These principles include:

1. Activity is situated, in two senses. Individuals act depending on the situations they have to cope with, which are variable, evolve in time, and require changes in the activity; and activity is also marked by the period and culture in which it takes place;
2. Activity is finalized, oriented by goals which are partly specific to the individual carrying it out. His/her goals may be different from the goals that have been prescribed by exogenous stakeholders;
3. Activity is integrative, it emerges at the intersection of the individual's own features (his/her aims, personal history, knowledge, skills, etc.) and the features of situations in which he/she acts (the goals that must be met, the material means provided, the work environment, etc.);
4. The activity developed by a specific individual in a given situation is unique: it inherits elements from his/her past. It is constantly revised and renewed.

In this perspective, learning and the development of vocational competencies are both a process and a product/result of activity. More specifically, they are a result of the constructive dimension of activity, which is the dimension oriented towards the elaboration of resources for oneself in future situations (Rabardel 1995/2002). Accordingly, it is then irrelevant to directly change external determinants of activity such as knowledge or competencies independently of situations. In contrast, we can act through the mediation of situations. That is why the notion of “situation” becomes a key element in the design of vocational training. The design of situations that entail a potential for development (Mayen 1999) leads us to question two dialectic processes: didactical transposition from the work situation to the training situation and transfer from the training situation to the work situation (Samurçay and Rogalski 1998).

This implies a shift in focus with respect to classical approaches of pedagogical engineering in adult training (Carré and Caspar 2011), which are widely used in the professional world. Following this classical approach, the contents of a training programme are derived from a frame of reference—related for example to regulations, to a specific trade, to technology, to skills, etc.—which people must then be trained to. In other words, this form of professionalization is based on *prescribed* work, which is necessary—but not sufficient—to cope with the realities of work. We must also move forward from a view of professionalization that is focused on the concept of knowledge, since the goal becomes being able to cope with work situations. We must, once again, keep our distance from a modular view of learning, in order to move towards a vision centred on the concept of training courses. This includes the temporal aspect of learning in the context of training courses. Lastly, we have to move away from a vision centred on regulations and/or prescriptions in order to integrate real-world work and the debate between real work and prescribed work.

13.4 Guidelines for Designing Vocational Training from Research in the Field

This approach is the result of an ongoing research programme concerning the development of vocational skills and the design of training systems, tools and situations based on work analysis. This programme hinges on several works of research in domains that involve risks, such as automobile driving (Boccara 2011; Boccara et al. 2014, 2015), aeronautics (Boccara and Delgoulet 2013, 2015; Delgoulet et al. 2015), work in a civil nuclear power plant (Fucks and Boccara 2014; Couix et al. 2015) or medicine in theatres of war (Delmas et al. 2015, ANR Project VICTEAMS).

Based on this research work, two main axes of progress in the design of vocational training have been identified and could become the basis for guidelines to train people to deal with work situations.

1. The approach requires project management in order to use participatory methods, including with end users (trainers and trainees) and integrate an analysis of works.
2. It needs to move from classical teaching-learning methods to “active” ones that often imply transformations of both the trainer and trainee activity.

13.4.1 Building a Participative Approach to Training Design Oriented by Works Analysis

The approach presented requires the inclusion of “works analysis”¹ in the management of a training design project (Boccaro and Delgoulet 2013). The scope of the analysis is not just the task or job that is the focus of the training, as is the case in the classical approach of training design (IAEA 1996). Instead, as a minimum, it involves analysing the work of production operators, of trainers and of trainees. The work analysis consists in

the global approach, where the activity analysis is integrated into an analysis of the economic, technical and social factors with which the operator is faced, and an analysis of the effects of the company’s operations on the population in question and of economic efficiency. (Daniellou 1996, p. 185, our translation)

However, this “works analysis” must be conducted at the crossroads of approaches defended in ergonomics and vocational didactics (Boccaro and Delgoulet 2015), because it is guided by the design of training/learning situations. This kind of works analysis aims to highlight the real-world work situation in production and in training, in order to identify the multiple horizons of the training situations to be defined: “training for what?”, “training how?”, “what device(s)?”, “for what purposes?” (Olry and Vidal-Gomel 2011), considering working conditions for training to be learning conditions for trainees (Chatigny and Vézina 2008). More specifically, this works analysis method provides the identification and analysis of characteristic situations of action (Daniellou 2004) in order to recommend training objectives (Olry and Vidal-Gomel 2011) by formalising baseline professional knowledge (Samurçay and Rabardel 2004) as well as didactic transpositions (Samurçay and Rogalski 1998). This refers to identifying the differences and similarities between these two types of situation from the point of view of the activities deployed, those which cannot be deployed, and those which it would be recommended to deploy in order to improve trainee learning and the development of their activity. The analysis of these differences might direct training course design and anticipate the modifications of the activity of trainers and trainees, and its conditions of realization. For example, we proposed the SITUATING method

¹We deliberately use the term “works analysis” with a “s” at the end of “work”. The reader can find a detailed explanation of this conceptual choice in Boccaro and Delgoulet (2015).

that could be integrated in a design training management project based on research in civil nuclear power plants domain (Couix et al. 2015). SITUAATING is a proposal for moving from a classical approach in design training—like *Structured Approach to Training* (IAEA 1996) in the nuclear domain—to an approach where training situations are designed from works analysis.

The project management must also question the strategic orientations of professionalization throughout the training design, e.g. those related to safety: do organizations wish to make their stakeholders able to cope with hazardous situations? Or are they restricting themselves to just enforcing and complying with the rules? Such an approach thus means safety issues must be documented, taking into account the diversity of work situations from the point of view of the organization and of its stakeholders, in the early stages of the training design process. Analysing the policies and structures surrounding professionalization, as well as the involvement of stakeholders (in particular managers and trainers) must be then an integral part of project management, as they are necessary conditions for driving evolutions in the content and orientations of training. For example, in the NIKITA project,² a phase of the analysis was dedicated to involving the strategic actors at the partner's site of the project in order to organize their participation in the project (Boccara & Delgoulet, 2013). Then, we progressively integrated several actors: trainers, teachers, trainees, prevention department (occupational risk management staff, occupational doctor), internal ergonomist, journeymen, team managers, line managers and the CHSCT.³ This phase helped to resize the scientific project through a re-examination of its “intentions” (Barcellini et al. 2014), not just by putting into perspective the knowledge developed in relation to the actual work and technological possibilities, but also in terms of the relevance, from a work standpoint, of the scientific options that had been validated up to that point. It led to a shift from the initial objective of using virtual reality to teach “professional gestures” within a course built around a future Virtual Training Environment (VTE) which would take full charge of the trainee, to a project, within a broader training context, to design a VTE which would help to develop the cognitive organization of the action when performing assembly tasks. It also highlighted the crucial role of the trainer in the learning which meant designing the VTE as a working tool for trainers as well as a learning tool for trainees. Furthermore, changing the intentions of the project from professional gestures to training in the cognitive organization of action impacted directly on the content and situation of training, and consequently the tool that we had to design.

²The “Natural Interactions, Knowledge, Immersive system for Training in Aeronautics” (NIKITA) research project, funded by the Agence National pour la Recherche (ANR) and coordinated by Domitile Lourdeaux from the Heudiasyc laboratory at the Université Technologique de Compiègne (<http://www.emissive.fr/nikita/>). This project aimed to build a Virtual Training Environment (VTE) for aeronautical assemblers.

³The committee of hygiene, risks and work conditions.

13.4.2 How to Support Trainer-Trainee Work Activity in Order to Improve Professionalization?

If the end goal of professionalization in the domain of safety becomes “making workers able” to manage risks (together) in an integrated fashion, within situated productive activities, there will be an impact on the trainer’s activity and on his/her role within the institution/organization. Both these points then deserve to be questioned using work analysis-based approach. Promoting such a goal for professionalization implies designing, implementing and “capitalizing” on forms of pedagogy and didactics where the trainees are actors within the situations with which they are faced. The term “situation” here incorporates the dimension of the organization of work as a social dynamic construct.

Within these situations, they must act and debate in order to learn and develop competencies. Furthermore, these training situations may serve as a medium to stage and to play out the issues surrounding the activity, the tasks, the variability, the problems and controversies that lie in real-world work. This implies, in particular, that trainers should be able to identify and “didactize” these objects belonging to situations of work, in order to turn them into objects of learning. The goal is also for trainers to have the power to “put up for debate” and “organize the debate” about rules and practices—whether these be prescribed or developed over time through the trade and professional customs with and between the trainees. This requires new pedagogical methods and tools to support the activity of trainers and trainees. The method of simulating works activities could be useful because it offers many possibilities and combinations to transpose the characteristics of real-world work activities: map, room training, verbal simulation, numeric simulation, full-scale simulation, etc. For example, Barcellini et al. (2014) proposed a method to simulate work organization for the design of work situations. This method could be transposed in the domain of training to simulate the organization of work situations, particularly to train mentors and managers in pairs or in cross-training with their crews. In the same perspective, work-based gaming tools could also be used to learn, discuss and debate rules and work process knowledge in order to make trainees able to cope with normal, daily and degraded situations.

More particularly, we built an ad hoc scenario-based gaming tool like this as a tool intended for trainers and trainees in cross-professional initial training to manage classical and radiological risks for workers in civil nuclear power plants in France (Fucks and Boccara 2014). The didactic tool is based on the real-world work process in order to create opportunities for trainees to experiment and discuss decision-making processes according to different work situations. The tool was designed to replicate different scenarios of work situations. Trainers could also adapt and increase the level of difficulty in terms of situation management and conflict resolution with and between the prescribed rules. Hence, this tool made it possible to discuss real work situations during the training, including the construction of the problem, as well as the way or ways it should be dealt with.

Following this perspective, the role of the trainer and of the trainees had to be analysed. The role of the trainer should not only be that of a guide, a coordinator or animator of contents (frames of reference, knowledge, rules, procedure, case studies, etc.) produced by others without them. Neither should the trainer be a “midwife” of knowledge without having any conceptual competence or experience in the trades and work situations they are training people in. Conversely, the role of the trainer cannot be solely to be an expert of the trade and of its related work situations, without having any pedagogical or didactic resources that make it possible to learn and to accompany workers in training in the construction of the desired competencies and skills. The goal here is to construct new trade-offs between the professional competencies of the trainers in the trades involved—viewed as objects of training—and the design, running, and evaluation of training programmes that are guided by and intended for work. In other words, this perspective leads us to question more broadly the work of trainers in sociotechnical production systems: Who can become a trainer? How does one become a trainer? What does the organization expect of the trainer? What is/are the possible career path(s) as a trainer? What is the future for trainers in organizations? What is/are the courses available to trainers for career development? These questions need to be answered and remain on the table throughout the training design process, because they deal with factors that may impact learning.

13.5 Conclusion

By way of a conclusion, we presented in this paper an approach to training design on the basis of works analysis in order to train people to deal with real-world work situations. We highlighted the fact that achieving this goal requires project management to take participatory methods into account, involving several actors of the company (trainers, trainees, managers, technical experts, etc.) and integrating an analysis of works both in training and in production. Training design needs to move from classical teaching-learning methods to “active” ones that often imply transformations of the activity of both the trainer and of the trainees. Thus, the dialectics between situations of work and training also invite us to think about the notion of *course of professionalization*, rather than about sequences of “moments of professionalization” to be inscribed in the career paths of the individuals involved. This suggests a need to think about continuity and/or breakthroughs in work situations and training situations, in order to foster connections between the two. Hence, this view questions the relationship between production and training in sociotechnical systems, in a more global and strategic manner.

Returning to the NIKITA project, the VTE was anticipated as an innovative tool in a training programme for temporary workers. The training system was based on a two-month period of initial training, followed by a period of several months of monitored work at the workstation. The workers were then considered to be autonomous. The workers could also have specific complementary training

according to the specific features of their workstation. As a reminder, the aim of the project was to build a virtual training environment. Designing a new training tool thus involved analysing the existing training system and tools in order to identify where it could be integrated, its objectives, and how it could lead to additional benefits for trainees as well as for trainers. In other words, it is essential to think about the complementarity and the compatibility of the different “components” of the training system (sequence, module, situation, etc.) from the early stage of training design.

If we extend this idea, this orientation requires data from human resources to be organized in terms of career paths, going beyond merely tracing job changes over the years. It therefore questions the managerial processes involved in identifying training-related needs and their evolution over time, in service of a professional “trajectory”. In other words, this requires longitudinal—rather than yearly—management practices, and questions the managerial and human resources processes of companies.

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