

## The design of effective safety training courses and differences in practice: an Italian study

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Awareness does not arise from passive learning of rules and procedures, but from proper education to a culture of safety. Safe behaviors are driven by the motivation and knowledge of the workers, and the participation and involvement of workers ensure optimal performance. This work, with a reference to educational learning theories, investigates how to make workers' training more effective by studying the impact of educational factors on adult learning. New approaches have been developed in recent years with the active involvement of the participants. A framework was built, starting from the literature, to connect different teaching methodologies and trainers' roles to educational factors. It identifies seven constructs for teaching methodologies, two for the trainer's role, and four for educational factors as drivers of effective training. A questionnaire was distributed to Italian trainers in companies offering safety training courses and the results confirmed the framework's structure. However, unlike the framework, role playing and group work teaching methodologies, which presume higher effectiveness of training, were not prevalent among trainers who preferred traditional methodologies like frontal lessons, participatory lessons, and personal experiences. These findings suggested a need for improvement in safety training activities. This study, developed before the spread of Covid-19, provides a starting point for further analyses to evaluate how things have changed over time and propose further improvements in the design of safety training activities.

*Keywords:* occupational safety, adult, surveys, learning, safety culture, education.

### 1. Introduction

Dealing with occupational safety ultimately means creating awareness of potential risks and hazardous situations among people (Takala et al., 2014). However, awareness does not arise from passive learning of rules and procedures, but from education to a culture of safety (Dyrborg et al., 2022; Micheli et al., 2022; Su et al., 2019). Each group of people is characterized by a 'culture' which affects how individuals make decisions. In an organization with a strong culture, health and safety are prioritized and there is an accurate perception of risks along with confidence in the efficacy of preventive measures. As the Advisory Committee on the Safety of Nuclear Installations (ACSNI) noted in 1993, 'the safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management' (ACSNI, 1993).

The safety climate constitutes a specific aspect of the broader concept of safety culture. Safety climate refers to the perception of workers feeling safe at the workplace due to effective management practices. Safety climate is considered a precursor to safety performance, and safety knowledge and safety motivation act as facilitators in the relationship between safety climate and safety performance (Neal et al., 2000). While safety compliance is often the sole criterion used to evaluate safety performance, safety participation is a vital parameter that contributes to better safety outcomes (Neal et al., 2000).

Building a safety (prevention) culture among workers is essential because their engagement makes a significant difference (Dyrborg et al., 2022). Effective education and training play a crucial role in promoting safety culture in organizations with a consequent reduction in injury or accident rates (Ahmad et al., 2019). This work, with a reference to educational learning theories, investigates how

to enhance the effectiveness of workers' training by examining the impact of educational factors on adult learning. To this end, a questionnaire was sent to companies offering safety training courses in Italy and a reference framework was utilized to better frame their responses.

The following sections start with a literature review on educational learning theories with a particular emphasis on adult learning (Section 2), the subsequent section (Section 3) outlines the research framework employed in the study, followed by a description of the research objective and methodology applied for the analysis (Section 4); the discussion of the results follows (Section 5), and the paper concludes with the conclusions and future research directions (Section 6).

## 2. Literature review

In light of the research objective, we aimed to explore how workers learn and consequently how training can be made more effective. To achieve this, we delved into educational learning theories (2.1) and examined various schools of thought, focusing in particular on constructivism and constructivist teaching, which emphasize the learner as the main protagonist of the learning process. Then, having recognized differences in learning processes across individuals of different ages, the andragogy theory is considered because it specifically studies adult learning (2.2). Finally, various traditional and new teaching methodologies for adult training are reviewed, assessing their strengths and limitations (2.3).

### 2.1. Learning theories

According to psychologist Ernest Hilgard's definition, learning is an intellectual process by which individuals acquire knowledge about the world and use it to structure and direct their behavior in a lasting way. It can be the result of spontaneous processes, or it can be driven by external factors (Jackson, 1956).

Educational psychology is a branch of psychology that studies learning processes and teaching processes. It identifies various factors that can affect the ease of learning, such as the environment, motivation, and personal well-being. There are three major schools of thought in educational psychology (Ertmer & Newby, 1993): behaviorism, cognitivism, and constructivism.

The *behaviorist theory* was born in 1913 and the basic idea is that behavior is determined by environmental conditions and that humans are passive beings (Watson, 1913). Therefore, psychology should seek explanations based on actual observed data rather than introspection (Skinner, 1938). Learning occurs when a connection is made between a stimulus from the environment, a behavior implemented by the subject, and a reinforcement that results from the action performed. This learning consists of the acquisition of habits and the associations between stimuli and responses. However, this conception of learning passively considers the role of the learning organism, emphasizing primarily the influence of the environment.

Towards the end of the 1950s, *cognitive psychology* emerged and shifted the focus away from the external environment, as behaviorism did, and instead focused on the learner who processes information (Bruner, 1960; Vygotsky, 1978). Collaboration between learners is seen as a key element of effective learning. Cognitive theories have a rationalist approach, as they believe that knowledge is the result of data categorization processes that follow mental stages defined from birth, which can be modified. In this context, the role of the trainers is fundamental, they must ensure that all the students possess the basic knowledge necessary to learn new knowledge and know how to use it in different contexts. The purpose of teaching is to lead learners in organizing and using their knowledge in different fields.

In the 1980s, a new theoretical orientation called *constructivism* emerged in educational psychology, which challenged the idea that knowledge can be received passively (Piaget, 1977). Knowledge is subjective and built through continuous interaction with others. There is no "knowledge" independent of the observer, as reality does not exist independently of the subject perceiving it. Rather, the environment provides an opportunity to gain experience and build knowledge. Knowledge is derived from the ability to recognize the new, adapt, and make new predictions. Experience is a series of constructions of expectations, their invalidations, and new constructions. Learning occurs through the failure of an expectation and the ability to create new constructions. In the constructivist view, absolute knowledge does not exist, and learning is a subjective reworking of knowledge. The trainer's

role is to facilitate this personal reworking of knowledge by the learners. The traditional lesson loses its centrality in the learning process in favor of direct experience. Learning is an active process of building knowledge through self-construction, determining the transformation of the learner into someone new. Therefore, the role of the trainer is evolving from that of an information provider (a teacher) to that of a facilitator of learning. The trainer presents problems and stimulates student reflection to lead them to construct shared knowledge. Thus, it is essential to create an engaging training environment that aligns with the interests and motivations of the learners. Collaborative learning is central to constructivism because knowledge is built through interpersonal interactions. Constructivism is gaining popularity because modern society requires individuals who are continuously engaged in learning throughout their lives.

## 2.2 The andragogy

Starting in the 1970s, researchers began to explore specific teaching methods for adult learners, with the studies of American Malcolm Shepherd Knowles (1913-1997) being particularly influential. Knowles recognized that adult learners have distinct characteristics that differentiate them from younger students (Knowles, 1984). These include:

*Self-concept:* adults have a sense of their own abilities and knowledge, which can sometimes create resistance to new ideas.

*Prior experience:* adults bring their past experiences to the learning process.

*Readiness to learn:* adults want to learn new things and are often highly motivated, but they might not be aware of their needs and have more limited time and resources than younger students.

*Learning orientation:* adults are inclined to learn effectively when they can relate new knowledge and skills to their real-life experiences.

*Motivation:* adults are often motivated by internal factors such as self-esteem, quality of life, job satisfaction, and personal interest.

The learner's responsibility and involvement in the learning process become central; learners must actively contribute to building skills and behaviors. The training must provide a stimulus for changing behavior, both inside and outside the workplace. The development of learning theories and studies on andragogy has highlighted key

elements of the training process that also apply to occupational safety training.

## 2.3 Teaching methodologies

The traditional frontal lesson is not an effective didactic methodology for adult learning because it primarily relies on the teacher's prepared content and ability to communicate. Participants are passive listeners who take notes and may ask questions, there is hence little interaction among learners and the learning process is not active. This teacher-centered approach may be suitable for large homogeneous groups, but it hinders the development of learners' cognitive and relational skills. It is necessary to evolve the traditional teaching method by creating more active and engaging learning environments, where learners can apply their own skills and experiences. The role of the trainers should move from being knowledge transmitters to facilitators favoring the learning process. This does not mean that the trainers become less important; on the contrary, they play an active role in planning and preparing lessons, stimulating learners to ask questions, and facilitating interactions during group activities. The aim is to make knowledge a means rather than an end, and trainers should strive to develop learners' critical thinking skills, making them independent problem solvers and promoting the idea of lifelong learning.

Some active and experiential methodologies are now presented since they would make adult training more effective and support the trainer's new role as a facilitator.

In the *participatory lesson*, the trainer asks questions to stimulate learners' points of view and encourage the exchange of information among participants, enriching their knowledge.

In the *analysis of personal experiences*, learners tell their personal experiences on a topic defined by the trainer who then invites participants to discuss and analyze what they have shared.

The *case study* analyzes a real situation, where the trainer provides all the necessary information to the participants to reflect, analyze, and classify the situation. The objective is not to solve the case but to develop problem-solving skills by identifying and classifying complex situations.

In *simulation*, learners actively experience different situations by creating a virtual environment, which is a simplified reproduction of reality, that simulates a working environment.

*Group work* involves dividing participants into small groups and assigning each group a task to be completed within a given timeframe. While participants are the protagonists of the activity, the trainer sets the problem to be solved and the working times.

*Role-playing* involves participants assuming pre-established roles and behaving accordingly, leaving room for their creativity. The game is played by two or more participants in front of a group of observers who try to examine and understand what is being represented. The trainer facilitates the activity through appropriate suggestions.

By incorporating these active and experiential methodologies, trainers can create more engaging and effective learning environments that promote critical thinking and problem-solving skills.

### 3. Research framework

The literature review on learning theories and teaching methodologies provided a comprehensive background for investigating how to improve the effectiveness of safety training courses. A research framework was developed, incorporating deductive constructs to evaluate the efficacy of training activities. The framework comprises three main blocks: teaching methodologies, trainers' roles, and educational factors.

The first two blocks, teaching methodologies and trainers' roles have been discussed in the literature. The study selected seven teaching methodologies - *frontal lesson*, *participatory lesson*, *analysis of personal experiences*, *case study*, *simulation*, *group work*, and *role-playing* - and two trainers' roles - *teacher* and *facilitator* - for the analysis. The third block, educational factors, was not explicitly identified in the literature but derived implicitly from the findings. Four factors were identified as key enablers of effective training, including *the development of problem-solving skills to foster autonomy*, *interaction with others*, *practicality*, and *experiential learning*. The deductive relationships between the three blocks have been constructed for empirical testing in a survey, as later detailed in the next section. The major relationships are outlined below.

If we consider the facilitator construct, we can see that it is associated with the six active teaching methodologies but not with the frontal lesson. Hence, when trainers decide to play the role of facilitator, they are expected to use active learning

methodologies, while when they decide to play the role of teacher, they are expected to use frontal lessons. Similarly, there is a direct relationship between teaching methods and effective training factors, while the role of the trainer has an indirect relationship with effective training factors. As illustrated in the figure, the frontal lesson has no connection with effective training. It places the trainer at the center of the lesson, leaving learners in a passive role without interaction. The analysis of personal experiences and the participatory lesson are only connected to the experiential factor since they are useful for enhancing the experiential contribution of participants but are not practical methods that enable the development of analytical and problem-solving skills. The simulation method is associated with practicality and experientiality since the participants are stimulated to gain practical experience in a situation similar to reality and compare it to their own experiences. The case study refers to three factors: problem-solving, interaction, and experiential learning. Through the study of a case, participants, according to their experience, can analyze a situation either alone or in a group and discuss it with others. Finally, the group work and role-playing methods are the only ones that include all four relationships. These methods make learners fully active and the protagonists of the lesson, promote interaction with others, develop their critical thinking skills, and enhance their overall learning experience.

We have observed that the different teaching methods have varying levels of interaction with the effective training factors, ranging from a minimum of zero in the frontal lesson to a maximum of four in group work and role-playing. Thus, we can assess the effectiveness of the training by including as many factors as possible, and accordingly, determine the significance of the various methods based on the number of interactions they have. This is represented in Figure 1.

### 4. Research objective and methods

The built research framework aims to enhance the understanding of how to improve the effectiveness of safety training courses, by testing the framework and inner relationships, starting from studying the Italian environment, and investigating differences, if there are, other factors, not already included, considered relevant by trainers.

To this end, a questionnaire was sent to 528 Italian companies that offer safety training courses.

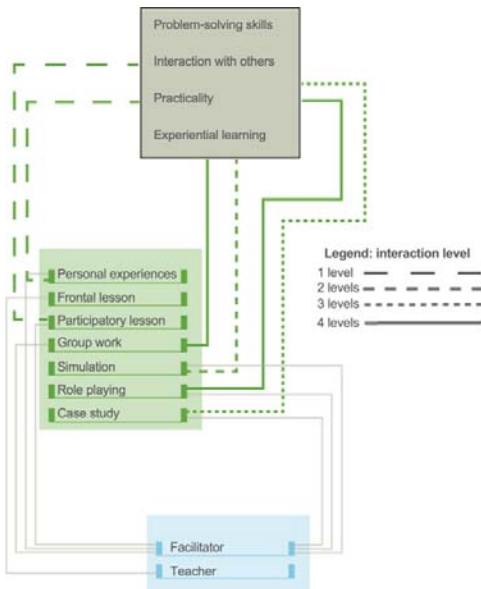


Fig. 1. The research framework: teaching methodologies, trainers' roles, and educational factors

Responses, 95 out of 528, (18% of the sample) were analyzed to detect whether there were differences between the framework and the companies' reality and identify actions that could lead to more effective training courses. The questionnaire consisted of 14 questions, including multiple-choice, matrix, and classification items, which were divided into three categories: company information, course structure, and qualitative assessments.

In the first phase of the data analysis, we examined the relationship between companies' responses regarding the role of the trainer (facilitator or teacher) and the frequency with which they employed the seven teaching methods outlined in the framework. To do this, it was designed a multiple-choice question with four response options (continuously, often, rarely, never) for each teaching method. We then conducted a frequency analysis of the 95 company responses. The answers were grouped into four categories based on the facilitator/teacher ratio (a question in the questionnaire): 100% facilitator, 60% facilitator/40% teacher, 40% facilitator/60% teacher, and 100% teacher. The answers of each group were reported in separate tables and different weights to the four possible response options were given. Specifically, we assigned the following

weights: continuously (100%), often (70%), rarely (30%), and never (0%). These weights were then multiplied by the number of responses for each teaching method.

In the second phase of the research analysis, we asked trainers which factors they considered most effective for training learners to implicitly evaluate the active teaching methods defined in the framework. A four-level scale with the following weights was used: fundamental (100%), very important (70%), not very important (30%), not important at all (0%). These data were then compared with the answer given by the companies about the number of their trainers to determine whether the selection of the teaching method changed based on the number of trainers employed by the company (less than 10, between 10 and 30, between 30 and 50, more than 50). Furthermore, it was tested whether there was a significant difference in the responses between companies that only offered training courses and those that were also engaged in other activities.

Finally, in the same question asking for effective teaching methods, captious factors (not present in the research framework) were added to test trainers' thoughts such as *clarity in the explanations*, *level of education of the participants*, *the environment in which the lesson* and *interest of the participants*.

Overall, the aim was to gain a deeper understanding of the most effective teaching methods and factors influencing learner engagement and retention, both within and beyond the research framework.

## 5. Results and discussion

### 5.1 Linking the role of the trainer with teaching methods

The data presented in Figure 2, show the frequency of responses for the seven teaching methods in relation to the four cases of trainer's role. The results indicate that trainers who view their role as that of a teacher prefer frontal lessons, while those who perceive themselves as facilitators tend to choose case studies, participatory lessons, and personal experiences. As a result, frontal lessons are less frequently utilized in these contexts. Regarding the companies that opted for a facilitator/teacher ratio of 60%/40% or 40%/60%, there are no significant differences in the selection of teaching methods. As seen in Table 1, the



percentage difference between the two trainers' cases remains below 6%.

Table 1. Percentage differences between facilitator/teacher ratios of 60%/40% or 40%/60%.

Frontal lesson	5%
Simulation	5%
Case study	3%
Role-playing	1%
Participatory lesson	6%
Personal experiences	0%
Group work	6%

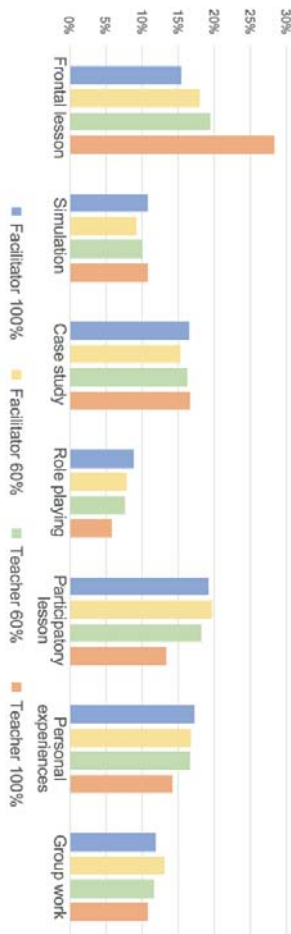


Fig. 2. Absolute frequencies between teaching methodologies and trainers' roles.

Subsequently, the relative frequency of every teaching methodology compared to the others is

represented in Figure 2, where each teaching methodology also considers the responses grouped by facilitator/teacher ratios. Our analysis reveals that trainers currently make little use of simulation and role-playing as teaching methods, with frontal lessons, participatory lessons, case studies, and personal experiences being preferred instead. These results suggest there is any significant relation between the trainer's role and the choice of teaching methods.

Furthermore, Figure 3 indicates that most companies have opted for a combination of facilitator and teacher as their trainers (47 companies selected a facilitator-teacher ratio of 60%/40%, while 36 companies chose 40%/60%). Only eight companies selected a facilitator-only approach, while four companies opted for a teacher-only approach.

Recurring links were identified between roles and teaching methods, reflecting what was defined in the framework. However, some links were not confirmed due to the low significance of the responses but were not excluded either. The confirmed links are as follows:

- Teacher – Frontal lesson
- Facilitator – Analysis of personal experiences
- Facilitator – Participatory lesson
- Facilitator – Case study

Despite encouraging findings on active methods, 42% of respondents believe that trainers should predominantly act as teachers. Consequently, a good percentage still relies on the 'old' way of training participants, and it is expected that most of them still use the frontal lesson as the main teaching method.

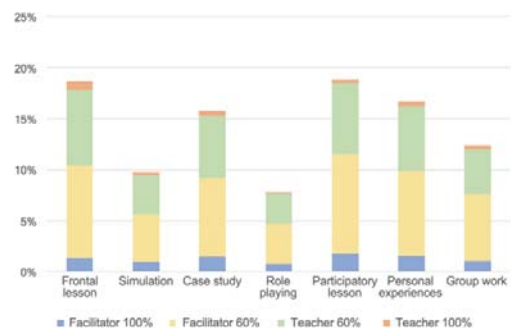


Fig. 3. Frequencies of teaching methodologies subdivided by trainers' roles.

### 5.2 Active teaching methods

As regards the analysis of the methods, the trainers identified participatory lessons and personal experience analysis as the most effective methodologies for training learners, while group work and role-playing were considered the least effective. This result, however, contradicts the framework that identified group work and role-playing as the two most effective methods.

To further analyze the results, two clustering were applied based on the number of trainers per company and their level of expertise. The first clustering based on the number of trainers in the company revealed that the teaching methods identified as most effective did not change significantly, except for marginal cases. As a result, regardless of the type of company, participatory lessons and personal experience analysis remained among the most effective methods, while group work and role-playing were considered the least effective. Similarly, the second clustering based on whether the company only deals with training or not showed no deviation from the general analysis.

Companies did not attribute the same value to active teaching methodologies as envisaged by the research framework. On the contrary, they valued those methodologies that satisfied only one of the four factors of effective training, i.e. experiential learning. As a result, it appeared that the other three factors, the development of problem-solving skills to foster autonomy, interaction with others, and practicality were deemed irrelevant by trainers to train adults.

There might be two underlying reasons to explain this phenomenon. Firstly, trainers in their responses might have considered the complexity of implementing different methods when assessing their effectiveness. Participatory lessons and personal experiences are more similar to traditional methods and easier to apply, whereas group work and role-playing are more complex. Secondly, the trainers were not aware of the four factors we identified for effective training, which combination of all four led to greater effectiveness of courses.

### 5.3 Other relevant factors for trainers

One question investigated potentially relevant other factors for trainers, in addition to the factors already selected in the research framework. The results revealed that two factors, clarity in explanations and participant interest, were important determinants for improving training, which were

not initially included in the research framework. The two factors were then evaluated based on the previous classification, which was based on the number of trainers per company and their level of expertise. As in the previous case, regardless of the company's specialization and the number of trainers per company, these two factors had a significant impact on training courses.

In conclusion, some reflections can be made on these two additional factors, which were not included in the research framework but were considered relevant by the respondents. The trainers believe that the *interest of the participants* in learning is fundamental to promoting content retention. The literature, however, does not consider this element to be significant, as it is the participant's engagement that makes learning effective, regardless of their interest. On the other hand, trainers consider *clarity in the explanations* to be crucial because they often have a teacher-centered approach to the lesson. In contrast, educational theories, focus on a learner-centered approach, where the role of trainers is fundamental, but not limited to being a communicator. Therefore, clarity in explanations becomes no longer a key element in the latter approach.

## 6. Conclusions and further developments

We have seen that safety training should prioritize the learner's education and aim for a change in their behavior. This requires the constant involvement of the participant by using active teaching methods, particularly role-playing and group work, which result more engaging and impactful. By making the learner an active participant in the learning process, it is possible to train them more effectively.

Although there are several recent theoretical studies on teaching methodologies for adult training, when it comes to safety training applied techniques seem not to have changed in the last years, traditional methods still prevail in safety training courses. Frontal lessons, where content relevance takes priority over learner involvement, remain the most used method for training workers. More participatory and active courses are still lagging, and the reasons could be many.

Culture and environment could be major factors influencing the lack of innovation in safety training. The occupational safety field has traditionally focused on compliance with regulations, doing just what is required, rather than taking initiative and actively seeking to improve

safety training. As a result, there may be resistance to change and a preference for traditional methods, both on the part of trainers and learners. This can make it difficult to introduce more innovative and effective teaching methods.

To address these issues, it was built a framework to support the framing of the answers given by the trainers about the status of safety training, its effectiveness, and potential paths for improvement. By analyzing the 95 responses from the questionnaires, it became evident that most trainers preferred the traditional teaching methodology that prioritizes content relevance over learners' involvement. Involving the participants for the trainers simply meant establishing an interaction with them, rather than empowering them and developing their skills. As a result, learners remained passive and minimally involved, even in participatory lessons.

This also explains why trainers favored methodologies that are similar to the traditional way of training, such as participatory lessons and personal experiences. However, to effectively make learners active participants, it is necessary to enhance the use of methodologies that involve them more, such as role-playing and group work.

Given these premises, there are some study limitations and consequently several possibilities for further research. Firstly, the sample size could be increased by involving more companies and countries (beyond Italy), thus making the analyses more reliable. Secondly, a more in-depth analysis of the external factors that influence the trainers' decision-making could reveal new relationships between contextual factors and adopted teaching methodologies, potentially explaining the trainers' choices, and outlining how they can be optimized given a specific environment.

In conclusion, this study, which was developed before the spread of Covid-19, could serve as a starting point for future analyses to evaluate how things have changed over time and accordingly propose further improvements in the design of safety training courses.

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