

Participatory Ergonomic Design of a Safety Training Tool for Migrant Workers in Agriculture

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In Italy, about 25% of the non-family labour force in agriculture is represented by migrant workers. This growing number is mirrored by a high rate of occupational injuries involving migrants. For the year 2011 statistics report 38.4 cases of injuries per 1,000 migrant workers, whereas the rate was 35.8 cases per 1,000 operators among Italian workers. Language and cultural differences represent a relevant obstacle to effective safety training. Based on these considerations, a project was developed in the Piedmont region (northwestern Italy) to design a safety training tool based on visual rather than verbal communication, specifically addressing migrant workers' needs. The project is currently ongoing and the present contribution describes the main framework and the first results. An ergonomic user-centred approach and different qualitative methods are used to develop the training tool. At present, 6 trainers have been interviewed and 3 focus groups carried out with a total of 15 migrant workers. The first results show that the concepts of hazard, risk, (near) accident and the farm safety management system are not well understood and retained by the workers, while it appears that they have some knowledge about the use of Personal Protective Equipment (PPE). The visual training tool is under development. Each prototype will be discussed with different focus groups with migrant workers and trainers, and the efficacy of the final version will be tested by means of a quasi-experimental study with repeated measures.

1. Introduction

Agriculture is one of the most dangerous industries (Frank et al., 2004). Indeed agricultural activities involve a high exposure to a wide range of hazards, including dust, noise, thermal stress, chemicals, and ergonomic risk factors, which results in extremely high rates of occupational injuries, illnesses, and fatalities (Neitzel et al., 2014). As documented by previous researches, educational programs can have some positive effects on safety and health knowledge and behavioral practices (Murphy et al., 1996).

Behavior has been identified as a major contributor to accidents, and behavior modification is a primary focus in accident reduction (Ibrahim et al., 1999). Many studies stress the importance of changing unsafe behaviors through various educational measures and adequate health and safety training. With regard to this, Wirth and Sigurdsson (2008) indicated that awareness campaigns and comprehensive safety training are prominent features of a behavioral-safety process. Despite this, measures adopted up to now to promote agricultural workers' health and safety are recognized by many authors to be often inadequate (Neitzel et al., 2014).

Therefore, considering the unique vulnerabilities of agricultural workers, the development of effective and targeted training actions would represent a key element in promoting workers' health and safety.

1.1 Migrant labour force in agriculture

In regards to the composition of agricultural workforce, several analyses report the extensive use of foreign labour in high-income countries. In southern Europe, the use of migrant labour has dramatically increased in the agricultural sector. Most of migrant workers are employed with seasonal contracts for activities like picking fruits or ground crops, intensive animal farming, and livestock raising (ILO, 2016).

In terms of occupational safety implications, migrant workers are generally recognized to be a vulnerable workforce, and this is even more evident in a highly hazardous industry such as agriculture. Data collected from various authors suggest that migrant workers are exposed to higher safety risks than locally born workers. In U.S., Liebman et al. (2013) mention the alarming number of accidents among migrant workers and an injury rate twice as high as that of local workers. Flynn (2014) reports that workplace fatality rate of Latino immigrants is almost 50% higher than the rate for all other workers.

According to available scientific literature, the main risk factors for the increased vulnerability of migrant workers can be summarized as: i) language and cultural barriers, ii) inexperience and inadequate training, iii) hard working conditions and longer work shifts. Language is recognized as the major risk factor, since difficulties to understand occupational safety and health (OSH) rules can indeed expose workers to many dangerous situations. In addition, as reminded by Perla et al. (2015) cultural and linguistic barriers may interfere with the report of health concerns, request or access to OSH information, and/or access to health care. The adoption of new technologies in the agricultural (Cavallo et al., 2014) and forestry industries (Ferrari et al., 2012) enhances this issues. In this context, a new approach to the management of health and safety of migrant workers is needed (Bust et al., 2008).

1.2 Safety and health training for migrant workers

There have been a number of studies published about the OSH of migrant workers. However, most of these studies address sectors other than agriculture, such as the construction industry (Bust et al., 2008). In addition, when dealing with agricultural migrant workers, the studies refer mainly to North America migrant workers (Menger et al., 2016), while other cultural contexts are little explored. Some previous studies reveal that in order to communicate essential health and safety information two main categories of methods have been adopted, i.e. the translation of safety information and the use of interpreters on the one hand, and a variety of visual methods on the other hand (Bust et al., 2008). With regard to these methods, Neitzel et al. (2014) suggest that traditional written safety and health training materials may not be either universally acceptable or useful, whereas images and videos can be a more effective methods of communication.

Most authors recognize the importance of assessing the effectiveness of these methods, as well as the need to adapt them to an audience of migrants. At the same time, few training tools have been implemented in agriculture taking into account the target population during the design phase, and very little research is available about the evaluation or efficacy of actual farm safety training programs. This issue may be overcome by adopting a participatory ergonomic approach to the design and evaluation of the training materials (Burke et al., 2006).

1.3 The “Safety has no limits” project

In Italy, the migrant labour force has become a fundamental element of the entire agricultural sector. Official statistics denote an upward trend in immigrant farm work in most regions and at present, the migrant work force accounts for approximately 320,000 operators, representing about 25% of the non-family labour force in agriculture (CARITAS-MIGRANTES, 2015). More than half of the total foreign agricultural workers come from Eastern Europe: Romanians (114,856), Albanians (23,889), Poles (18,947), Bulgars (12,383) and Macedonians (9,766). Other countries of provenance of migrant farmworkers are Morocco, India, Pakistan, China and North Equatorial African countries. The nationality of migrant workers is often linked to a kind of "ethnicization of tasks" (INEA, 2012): for instance the Moroccans, Pakistanis and Indians are usually employed in animal husbandry, Romanians and Poles usually dedicate to plant nursery, while Albanians and Macedonians are often occupied in grape and fruit harvesting operations.

The growing number of migrants employed in the agricultural sector is mirrored by the high rate of occupational injuries in which these workers are involved. The most recently available data reveals a significant increase of occupational injuries and diseases between years 2013-2014 (Direzione Generale dell'Immigrazione e delle Politiche di Integrazione, 2016). As reported by the Italian National Insurance Institute for Employment Injuries (INAIL, 2011), for the year 2011 the incidence of injuries was 38.4 cases per 1,000 operators among migrant workers, whereas the rate was 35.8 cases per 1,000 operators among Italian workers.

Italian regulations on occupational health and safety (D.Lgs. 81/2008), in application of the European Directives on measures to improve safety and health at work, urges employers to give their workers adequate safety training. However, very little has been done to assess the comprehensibility and effectiveness of this mandatory training for foreign workers (Vignoli et al., 2014).

In Italy, some previous initiatives focused on improving agricultural migrant workers' training have been launched at a regional level. However, these projects typically count on verbal communication, by resorting to a translation of safety information or the use of some interpreters: none of these solutions appear to take full advantage of the benefits given by visual communication.

Based on these considerations, a project was developed in the Piedmont region (northwestern Italy) to design a safety training tool based on visual rather than verbal communication, specifically addressing migrant workers' needs and adopting a user-centered approach. The final aim of the project is to increase the awareness of proper safety culture and to promote the adoption of safe behaviors during daily work among migrant workers.

The Piedmont region is a relevant area where to investigate the issue, since in this region 53.5% of non-family labour force is represented by migrant workers. Moreover in Piedmont, the province of Cuneo is among the first Italian provinces for the number of migrant workers in agriculture sector (3.3% of total migrant workers in Italian agriculture, Coldiretti, 2014).

2. Materials and Methods

2.1 The steps of the “Safety has no limits” project

The project is being developed in five steps (Figure 1). Step 1 entails an analysis of the existing training courses and teaching materials to identify proposed contents and the strategies used for the communication. Both scientific literature articles, and existing and past training projects and materials developed in Italy and worldwide are analyzed. Next, in Step 2, a series of focus groups are conducted with different users of the training process i.e. trained migrant workers employed in agriculture and trainers of the largest Italian agricultural labour union, to point out: a) the information needed to be given during training courses to comply with current Italian OSH legislation; b) the most and least comprehended topics by migrant workers; and c) the formats and media which may help in enhancing workers' comprehension of different topics. In Step 3, considering the needs and requirements raised in Step 2, the new visual training tool is drafted. The graphical layout of the tool is defined during different workshops with a graphic designer, an ergonomist, and an agricultural safety expert, to ensure that the graphical solutions comply with ergonomic principles of visual communication, while maintaining the appropriate meaning and relevance. After different graphical prototypes are developed for each critical content, they are discussed and evaluated with the initial groups of migrant workers and trainers to identify the most acceptable solution in terms of comprehensibility and visual pleasantness. In Step 4 and Step 5, the effectiveness of the new training tool is tested by means of a quasi-experimental study with repeated measures. A new sample of migrant workers is identified (no workers from the previous focus groups participated in this phase) and divided into one experimental group and one matched control group. In Step 4, an assessment of participants' knowledge of safety practices at work is performed (T0, baseline evaluation) by means of a simple questionnaire. Then, the experimental group is trained with the new tool and the matched control group is trained with existing teaching materials during a safety training course offered by one of the largest Italian agricultural labour unions. Immediately after receiving the training (short-term assessment, T1), participants' comprehension of the contents presented during the training course is evaluated by means of a questionnaire in the two groups. In Step 5 the knowledge of the same topics is assessed again in both groups after 4 months (T2, follow up). At present, Step 3 of the project is being developed. Therefore, for the purpose of the present contribution, only the instruments and the results regarding Steps 1 and 2 will be described.

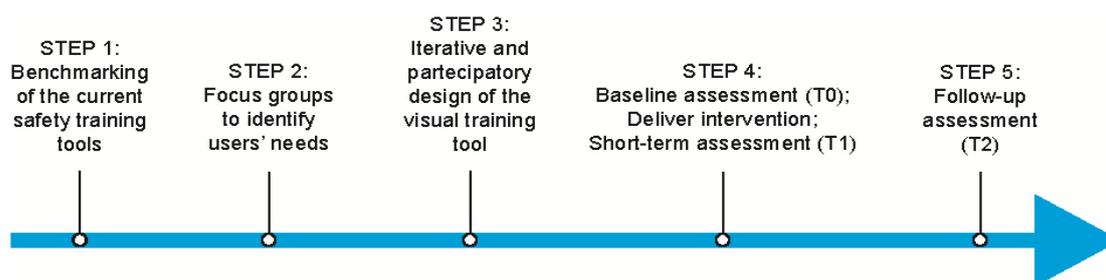


Figure 1: “Safety has no limits” project development steps.

2.2 Instruments

The analysis of the available training solutions was conducted through a systematic search of the most recent literature (from 2000 on) on different databases: ISI, Scholar, Science Direct, and PubMed. Different keywords were used to identify potentially useful articles: ‘safety and health’, ‘safety training’, ‘farm worker safety’, ‘agricultural worker training’, ‘effectiveness training’, ‘training method communication’. As regards training materials related to national and international projects, the same key words – both in English and in Italian – were used for a Google search.

Focus group questions were developed by the research team. Questions were reviewed for content and readability by an ergonomist and an agricultural safety expert, and modifications were made based on their suggestions. A semistructured questioning route was used in the focus groups to ensure consistency in questions asked across groups, yet allowing for some flexibility in accordance with topics raised and level of participation within the groups. Questions for migrant workers were primarily aimed at assessing: a) knowledge of the contents discussed during training activities (recall of the targeted subjects was prompted by means of both verbal and visual stimuli); b) relevance of the contents for their daily work life; c) suggestions for training modification (in terms of both contents and training strategies/media). On the other hand, questions for trainers were aimed at assessing: a) organization of training courses; b) contents and types of teaching materials; c) the most and the least interesting topics, according to trainees' feedback; and d) suggestion for training modification. After the focus groups, the participants filled in a socio-demographic form.

Focus groups took approximately 1 hour and were facilitated by a moderator and a comoderator. The focus groups were audio taped. They were transcribed verbatim and then subjected to a content analysis supported by the NVivo software v.11, to identify the most recurrent themes related to each investigated topic.

3. Results

Thirty articles were retrieved (Figure 2). Little empirical evidence is available in the literature about the specific communication strategies adopted in various training interventions (e.g. Morgan et al., 2002). Overall, static pictures -in particular step-by-step images- and animated pictures characterized by few details, easily allow comparison and re-inspection of the details of the actions. On the other hand, videos are fleeting: they can be reinspected but in motion, which may make it difficult to perceive all the minute changes simultaneously. This can cause cognitive overload and, as result, videos can be ineffective (Tversky et al. 2002). Nevertheless, short videos appear to be especially effective when they have to teach human motor skills (Ayres et al. 2009). Furthermore, graphic elements can be used together with a verbal description, to give a more accurate and engaging representation of the targeted concepts, to keep users motivated, and to improve comprehension (Tversky et al. 2002).



Figure 2: Analysis of the available training practices about OSH in agriculture.

In Step 2, 1 focus group with 6 trainers and 3 focus groups with a total of 15 migrant workers, already trained in agricultural safety (provenance: 13 India and 2 Eastern Europe; age: $M=37.06$ years, $SD=9.15$; length of residence in Italy: $M=9.00$ years, $SD=5.53$) were carried out in the province of Cuneo. The main themes cited by migrant workers and trainers with regard to the subjects of the training activities and possible developments were compared. Some similarities and differences emerged. The concepts of hazard, risk, (near) accident and the farm safety management system were reported as very important but difficult to transmit by the trainers, and were indeed the less recalled and known topics by the workers. The most recalled subject was the one related to the use of Personal Protective Equipment (PPE), even though participants had some difficulties in remembering which PPE should be adopted for specific hazardous tasks. Videos emerged as the preferred information source among the participants, whereas trainers encouraged the use of drawings and cartoons. Regarding the comprehension of safety pictograms affixed to agricultural machinery discussed during training courses, workers' answers varied depending on the specific pictogram considered. Pictograms referring to the need to read the user manual and the risk of tractor rollover were correctly recalled and comprehended by most of the participants. The pictogram warning against rotating knives yielded quite a good comprehension, whereas the pictogram referring to the risk of entanglement in the implement input driveline was poorly recalled and comprehended.

4. Discussion

Migrant workers represent a relevant part of the Italian agricultural population. To reduce the rate of fatal and non fatal accidents involving this kind of workers, focused training interventions are needed. In particular, a user-centered approach to the design of training materials can help in overcoming cultural and linguistic barriers which may hinder the effectiveness of the training process. The present contribution illustrated the first results of a regional Italian project, aimed at developing a migrant worker-centered safety training tool. The analysis of previous literature and (inter)national projects showed a lack of attention for the specific graphical solutions and media which can be adopted to communicate safety information to migrant workers. Both workers and trainers involved in the present investigation pointed out some strengths and weaknesses of the present training courses and materials and give suggestions for their improvements. The farm safety management system emerged in particular as a critical issue to be communicated and also the least comprehended topic by the workers. Since occupational safety is conceived as both a right and a duty for the workers (D.Lgs. 81/2008), finding new effective strategies to enhance the comprehension of this topic appear to be urgent. Regarding PPE, this topic seemed to be the most recalled and known by the workers, and this is encouraging if we consider that the use of PPE can reduce accidents and injuries associated with hazardous machinery, tools and materials (Baron et al., 2001). However, some further steps may be needed to stress and clarify the importance of PPE and their use. Given the importance of contextual cues (Wolff and Wogalter, 1998), in user-centered training materials, the PPE may be presented in their actual context of use, for instance, within scenarios of possible tasks for which each PPE might be relevant. Regarding safety pictograms, the present results are consistent with previous studies (Caffaro and Cavallo, 2015; Caffaro et al., 2017) and support the idea that users comprehended the safety signs to some extent but without getting a complete knowledge of them. Given that safety pictograms are supposed to play an important role in preventing accidents (ISO 11684, 1995), the presently observed rates of comprehension may indicate that safety communication is not being carried out effectively, compromising operators' safety and health. The following steps of the project are currently under development, to obtain the final version of the new training tool and to test its effectiveness.

5. Conclusions

The main outputs of this project will be a training tool able to represent an alternative to those currently adopted for safety training. In this new tool, language will not be a barrier to learning the behaviors and the regulations promoting operators' safety and health. The same ergonomic principles will be applied to the development of posters and flyers that will provide agricultural workers with simple but effective information and practical guidance on occupational safety and health. The outputs of the project will also be available on a multimedia interactive platform for free, so as to contribute to the dissemination of the research, its content and its results.

The expected outcome of the project can be summarized as:

- Increased spread of a proper safety culture and of awareness among farmworkers involved in safety training experiences;
- Increased adoption of safe behaviors during daily work by migrant workers due to the elimination of language barriers during the learning process of safe practices and behaviors;
- Increased workers' participation in farm safety and prevention system.

The long-term impact of the project can be summarized as:

- Transfer of the user-centered approach to the design of teaching materials to other industries employing a high rate of migrant workers;
- Reduction of injuries and accidents at work, occupational diseases, and lost working time due to accidents or illnesses
- Contribution to the improvement of the quality and overall safety in corporate activities.

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