



**Proceedings of the 2nd International Conference
of the Journal Scuola Democratica**

REINVENTING EDUCATION

VOLUME II

**Learning with New Technologies,
Equality and Inclusion**

ASSOCIAZIONE "PER SCUOLA DEMOCRATICA"

Edited by

The Organizing Committee the 2nd International Conference of the Journal Scuola Democratica

<https://www.rivisteweb.it/issn/1129-731X>



Published by: ASSOCIAZIONE "PER SCUOLA DEMOCRATICA"

Via Francesco Satolli, 30 – 00165 – Rome, Italy

Published in Open Access



This book is digitally available at:

<https://www.scuolademocratica-conference.net/proceedings>

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How to cite a proceeding from this Volume. APA citation system:

Author, N., Author, S., (2021). Title, in *Proceedings of the 2nd International Conference of the Journal Scuola Democratica "Reinventing Education", VOL. 2. Learning with New Technologies, Equality and Inclusion*, pp-pp

978-88-944888-8-3

Serious Games and non-Formal Learning in the Classroom: The Experience of *Sicuri si diventa*

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ABSTRACT: *This paper presents the results of a two-year participatory research conducted in 7 Italian schools with the goal of developing a new educational ICT tool about occupational safety that could provide a support for work-based learning programs that are currently mandatory in Italian high schools. Feedback from distinct groups of high-school students and teachers was collected and analyzed before, during and after the development of the tool, to co-create a product that could promote learning through experience and 'skills-based' learning, while drawing from the resources and interests that are part of young people's everyday life. The main output of the research was a serious game titled Sicuri si diventa (Becoming Safe), a role-playing game that can be used in and out of the classroom to help students become acquainted with health and safety regulations and to promote awareness about safety at work. We argue that the prominent levels of satisfaction shown by the students who tested the game prove that this kind of non-formal learning experiences provide a valid support to formal training and a useful addition to structured school programs.*

KEYWORDS: *Serious games, Non-formal learning Participatory methods, Work-based learning, Health and safety at work*

Introduction

As Roger Caillois (1958) has argued, in early industrial societies play has for a long time been considered nonproductive, an activity that carries no obligation, is free of real-life consequences, and has as such been banned from school and the workplace. However, with recent changes in the economic and cultural context, games and play have acquired a new significance. Play is based on simulation, like theatre, and, it is, for example, crucial for children in their processes of emotional and cognitive learning (Piaget, 1945). Games are now a staple in adult life too, and may take various forms, among which video games occupy a prominent place. It is estimated that in 2019, 39% of the Italian population between the age of 6 and 64 has played video games at least once, with slight differences among genders (53% of men and 47% of women) and the highest concentration in age groups 11-24 and 45-64 (Iidea, 2020).

Gamers have also given life to a thriving industry, which has been steadily growing for the past 15 years, reaching in 2019 a total revenue of 1.787 bn euros in Italy alone (ibidem). This data is impossible to ignore, and beg the question: can we consider video games as «cultural objects» (Griswold, 1994; Schudson, 1979) that have become relevant and meaningful for diverse groups of people? However, as Granic et al., have observed:

Against this backdrop of nearly ubiquitous play, the popular press regularly pulses out urgent warnings against the perils of addiction to these games [...] especially in children and adolescents. Indeed, the vast majority of psychological research on the effects of 'gaming' has been focused on its negative impact: the potential harm related to aggression, addiction, and depression (Granic et al., 2013, 67).

Notwithstanding, at the same time extensive research has been carried out regarding the benefits of video games in several different domains, like the «cognitive (e.g., attention), motivational (e.g., resilience in the face of failure), emotional (e.g., mood management), and social (e.g., prosocial behavior)» areas (ivi, 66). Schouten et al., have argued that, in a complex field such as city-making, games and play can help construct a special quality of social bonding, by acting «as critical tool(s), e.g., procedural rhetoric that allow people to reflect on the future of their cities», and «to imagine possible alternatives» (Schouten et al., 2017, 24). Moreover, games are increasingly used as educational tools in a variety of contexts (Gee, 2006). As several studies have shown, game-based learning can promote student motivation and interest in the subject matter by adding an element of «fun» and the opportunity of first-person experiences: this makes learning not only more enjoyable and compelling, but more effective as well (Prensky, 2002).

The research presented in this paper moves from the assumption that the use of video games can also be introduced in structured school curricula, as 'non-formal' support for formal education programs. For our analysis, we define «non-formal learning» (or contextual learning) as the result of practices embedded in planned activities that are not formally designed for teaching, but which can contain an important learning element (Colardyn, Bjørnåvold, 2005). We focus here on a specific type of video games, «serious games», whose primary purpose is to inform, train and engage rather than pure entertainment: using storytelling, these games transport the player into the «serious meaning» behind the game action (Michael, Chen, 2006). As Zhonggen has observed,

Serious games are referred to as entertaining tools with a purpose of education, where players cultivate their knowledge and practice their skills through overcoming numerous hindrances during gaming [...]. Educational elements can be integrated into the gameplay, which will be subconsciously acquired by the players during the gaming process (Zhonggen, 2019).

Our paper discusses the results of a three-year research project which set the main goal of creating an ICT tool to be embedded as an educational support in occupational health and safety training, which is currently a curriculum requirement for work-based learning (WBL) programs in Italian schools. Students and teachers from 7 Italian schools were actively involved in the co-creation of this tool, which eventually took the form of a serious game on occupational health and safety, called *Sicuri si diventa* (Becoming safe). The experience gained from the process of development and testing of *Sicuri si diventa* is used here to explore the role and potential of non-formal, ICT-based educational tools in a formal teaching environment.

1. The project

Serious games, research has shown, have proved to be an effective tool for educators in a wide range of different learning contexts (Carvalho, 2017; Zhonggen, 2019). In this specific variety of video games, educational elements are part of the gameplay and players are thus engaged in learning activities through fun and entertainment: easiness in use, surprises in the story-script, and open-ended situations have been found to be influencing factors for the effectiveness in learning outcomes, especially among young players (Iten, Petko, 2016; Wouters et al., 2017). Although they might be classified as a non-formal, ICT-based learning activity, serious games can be easily integrated into multiple learning environments, including the structured learning that takes place in middle and high school.

Sicuri si diventa was developed in the context of a project that saw the collaboration of the University of Bologna with INAIL (Italian National Institute for Insurance against Accidents at the Workplace) and local health authorities from 3 different Italian regions (AUSL di Modena in Emilia-Romagna, AUSL di Viterbo in Lazio, ASUR Marche), as well as 7 schools that offered 3 different academic curricula (agriculture, construction and architecture, industry and craft trades), located in the same regions. The objective of the project was to draw interconnections between three different key dimensions: the technical-normative stance inherent in the health and safety training; the limits posed by school programs; the students' needs and beliefs.

This was achieved through different actions and methods:

- A focus on the role of social practices (e.g. communities of practice);
- The use of participatory methodologies;
- The promotion of reflexivity and role-taking among students;
- Identifying peer-to-peer ambassadors/influencers;
- The use of non-formal contexts and languages;
- The promotion of awareness regarding rules and regulations.

2. Methodology

Our research was structured in 8 steps, based on participatory methodologies in order to build a process of co-construction framed in social communication theory (Lefebvre, 2012):

- Qualitative research in 4 Italian high schools, involving 12 teachers and 60 students. We conducted individual interviews and focus group discussions about their representations of risk in general and in the workplace, but also regarding their experience with learning and teaching health and safety-related subjects.
- These meetings also served to create a smaller group of 12 students that voluntarily offered to act as «peer ambassadors», with the task of conducting additional interviews to friends and acquaintances and collaborating with us (face-to-face and via an instant messaging platform) during the design phase of the video game.
- A quantitative survey, in collaboration with health professionals from the health authorities involved in the project, submitted to 277 students (63% boys and 37% girls) of the last three years of 7 high schools, to verify our knowledge of their representations of risk and learning activities on safety, and to evaluate their skills in risk prevention.
- Design of a project for a serious game on occupational safety based on our analysis of the main findings from the previous phases, as well as on the results of a second questionnaire submitted to 49 students of 2 high schools to evaluate the beta version of the video game, and on informal and formal dialogues with teachers and health professionals.
- Development of a beta version of the serious game *Sicuri si diventa*, in collaboration with the developers of a software house.
- Organization of a competition involving 75 students of two high schools divided into teams, who were asked to test the beta version of the game.
- A user survey about the satisfaction and commentaries on the videogame, submitted to the 75 students who tested the game.
- Development of the final version of the video game, which was perfected according to the observational and quantitative findings, and then tested in a competition held during a national event with 39 students from 2 different schools.

3. Representations of risk and safety among young people

The qualitative and quantitative findings from the first two phases of our research gave us a clearer image of the representations and definitions of risk among young people who are about to make their first experience of the workplace. In particular, the main interpretative frames (Entman,

1993) that we could identify from the discussions developed during the focus groups were: 1. Necessity (to work and therefore to take risks); 2. Making profits (as entrepreneurs, which again requires accepting risks); 3. Being challenged (as a positive, desirable aspect of work); 4. Experience as the most valuable protection (it is often, but not always, useful to avoid risks); 5. Fate as unavoidable (e.g. «We cannot prevent everything», and anyway a minimal distraction or machine malfunction can always render any previous knowledge useless). Among the most significant quotes from the students involved in the focus groups, several touched on the ideas of 'fatalism' and the importance of using 'common sense' in the workplace:

A more dangerous job pays more

You may get hurt, but in the end it is still acceptable, your life is not ruined

It is more comfortable to work without safety gloves or masks

The combine harvester is dangerous, but you have to use it

A little common sense is enough... it's not like you can go to work wearing flats

Therefore, many interviewees suggested that risk at work is often associated with the need to save time and to save money and, consequently, to maximize a company's and the workers' profit. In this narrative, the line between acceptable and unacceptable risks becomes progressively more blurred, with some of the students even implying that workers can, after all, accept to sustain minor injuries and that accidents, unless they cause permanent physical damage, can be a part of a person's work experience. This perspective also includes an underlying fatalism which relies on «common sense», rather than on the respect of rules and regulations, to avoid accidents and preserve the health of workers. Significantly, also recurring in the students' answers is the concept of «experience». Trust, they argue, is easier to place in older colleagues who, in time, have acquired enough experience to guide and teach them how to be safe in the presence of risks.

The findings of the survey confirm these trends, especially regarding the strong association between risk and fate (e.g., the unexpected), risk and lack of attention, rush, convenience, and habit (see figs. 1-2). These same aspects also emerge from other control questions, for example we can see that the lack of attention is considered the third most dangerous risk, after two events – fall from heights and cutting.

The perception of danger and risk inherently associated to the workplace is confirmed by the results shown in fig. 3, where working is considered more dangerous than car accidents or even home accidents (dramatically underestimated by our interviewees). Moreover, the

construction sector is represented as the most dangerous, underestimating other extremely dangerous sectors such as agriculture.

Partially different results emerge from qualitative and quantitative data concerning the students' evaluation of the effectiveness of health and safety training at school. While the small percentage (27%) of the students who have attended safety courses generally consider them useful, in the focus groups students explicitly point to the excessive abstraction of «boring power point presentations», as opposed to the effectiveness of direct experience. However, when the survey asks to rank six forms of training from most to least effective, almost half of the respondents (N=235) indicate «direct experience» as the most effective form of health and safety training, while 39% think that traditional lectures, like the ones they are required to attend at school during institutional health and safety training, are the least effective. It is particularly interesting to note that 'simulations' are considered the second most effective form of training (fig. 4).

FIG. 1. Words associated with risk (% of answers 8-10 on a scale from 1 'None at all' to 10 'Very much'. N=277).

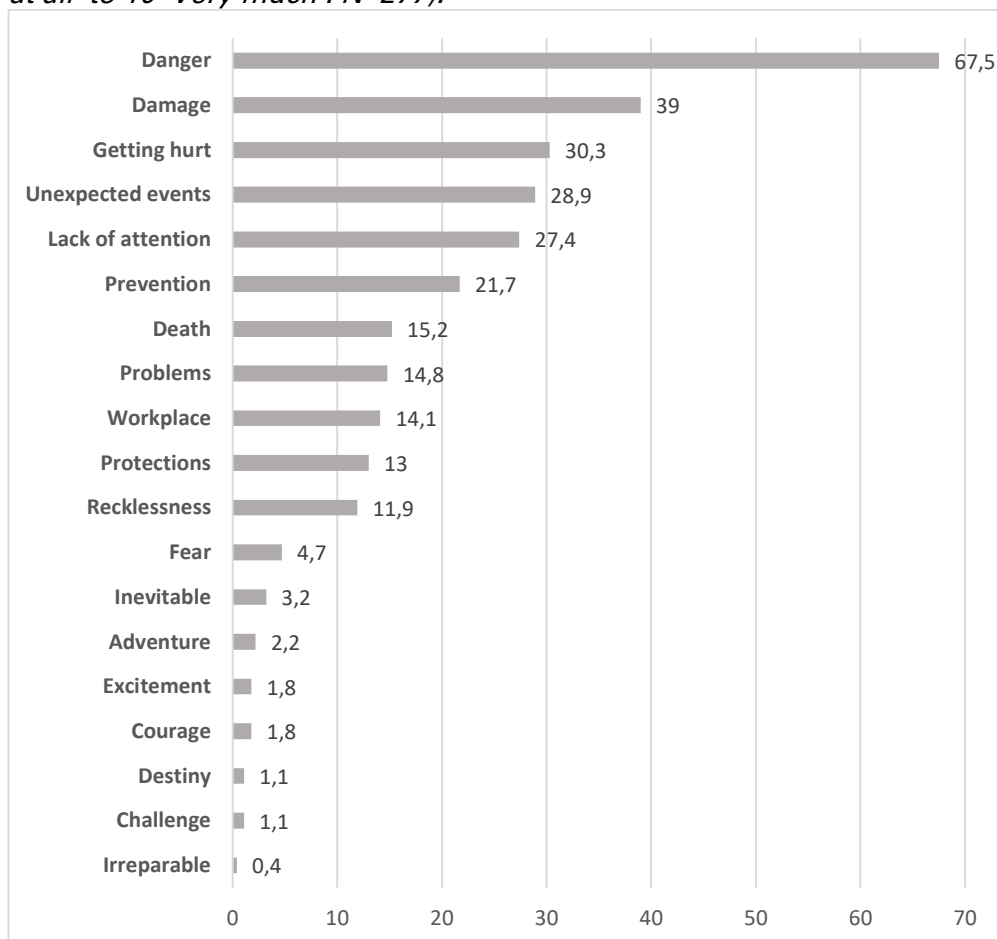


FIG. 2. Why do you think people take risks at work? (% of answers 8-10 on a scale from 1 'None at all' to 10 'Very much'. N=277).

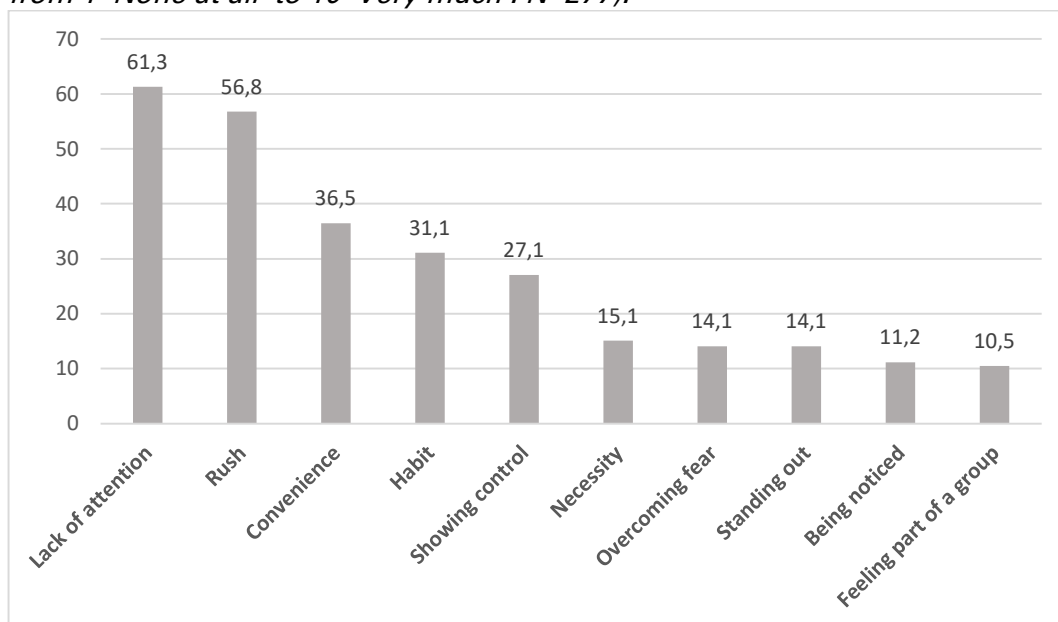


FIG. 3. Activities associated with risk (% of answers 8-10 on a scale from 1 'Not at all' to 10 'Very much'. N=277).

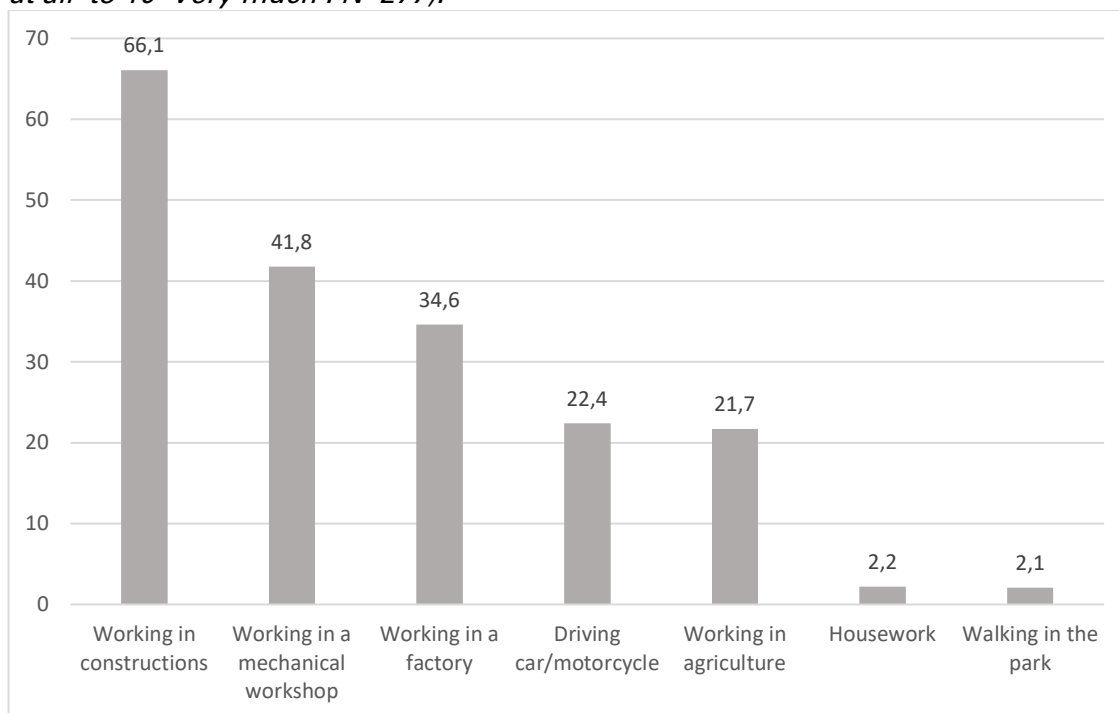
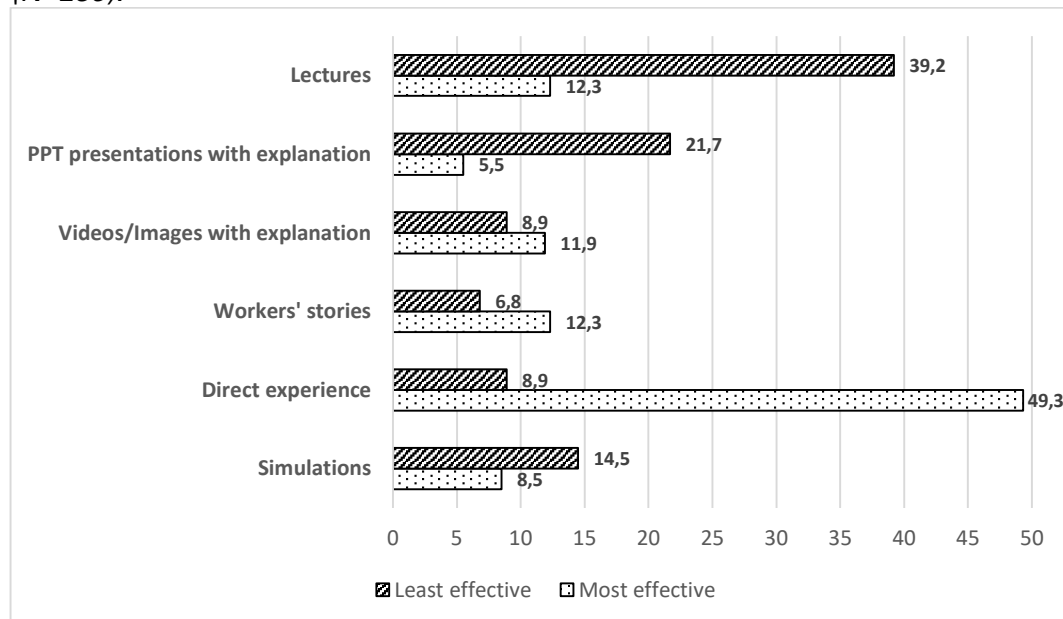


FIG. 4. Percentage of types of training considered most and least effective (N=235).



4. A serious game on health and safety: the making of *Sicuri si diventa*

These findings suggest that any kind of active promotion of health and safety in the workplace has to consider two different perspectives that interact with each other in the process of definition of risk: the expert-technical perspective and the perspective of social practices. In fact, our analysis points especially to the social nature of the representation of risk, which is shaped by cultural frames that are internalized through an individual's socialization in a group or an organization. Based on this assumption, we collaborated with health professionals and technicians to design a series of typical situations that could be translated into young people's languages and experiences that they are likely to encounter at work. The main goal was to recreate a range of choices with which students may be confronted in real life, so that they could have a first-hand experience of the consequences attached to each possible course of action. Moreover, we needed a tool that could support both individual empowerment and teamwork, to foster sharing practices and mutual improvement.

These objectives could be attained only by actively involving the students in the design of the gameplay mechanics as well as in making the main decisions regarding the educational content of the final video game. The very idea of choosing a video game as a learning tool on health and occupational safety for young people stemmed from the suggestions given by students and teachers in the course of the research. The researchers then collaborated with a team of developers to create a new game-play experience, while also keeping a close eye on the latest

trends in gaming for young people, and especially for the age group that was relevant for the purposes of the project. The technical contents – in terms of rules and regulations for health and safety in the workplace – were negotiated with health professional and health and safety technicians.

Sicuri si diventa has been designed as a learning tool and as support to mandatory training, to be used in and out of the classroom to help develop a health and safety culture beyond the teaching of technical and legal issues. A key goal of the project was to achieve engagement through fun and entertainment, which, as the literature on serious and educational games suggests, is one of the positive outcomes of playing games. The structure of the game encourages interaction, since it is designed to actively engage the players' agentive behaviors. Testing conducted with groups of high-school students has shown that the game is suitable for both individual and team play and therefore can be played cooperatively or competitively. It can be played on different devices, from PCs to smart devices like tablets or smartphones.

It is a management simulation game set in a 3D environment with a third-person overhead view, a choice that allows the player to navigate the game easily and move rapidly through the different scenarios. The main scenarios include simplified versions of three different work environments – agriculture, construction and manufacturing – graphically translated in the style of some of the most popular video games among the target users of the project (i.e. cubic and pixelated, similarly to games like Minecraft that are widely played among young people). The goal of the game is to win a race against time to prevent accidents, protect workers and build a safe workplace. The overall tone, sound and graphics are left intentionally unobtrusive in order to create an immersive role-playing experience for the player. Each student can play the role of a junior health and safety manager, initially guided by a senior manager who explains the basic rules and regulations that have to be followed to guarantee the workers' safety. The senior manager then leaves, entrusting the player with the responsibility of keeping the company productive and safe at the same time.

In order to achieve goals and gain points the player has to apply safety rules and learn about their context of use: by enhancing safety and preventing accidents, the safety manager ensures the mental and physical well-being of the workers and eventually helps the company become more successful and grow in terms of number of workers and overall production. As we observed, the focus on the conceptual equation between safety and business growth was one of the key suggestions that emerged from the interviews with students, which often contained references to the commonly held belief that the application of health and safety rules inevitably involves a loss of time and money for both entrepreneurs and workers. Therefore, the game includes progressive incentives and prizes: for example, each day without accidents is rewarded with credits that can be invested in new materials or the

introduction of additional workers. At the same time, whenever a worker suffers an injury, the player loses points and positions in the high-score table.

The interaction mode follows the gameplay mechanics typical of a puzzle-platformer game in an RPG context – where the player has to drag and drop objects and tap or click to use them. Some of the students suggested the introduction of a competitive element to the game, which was added in the form of customizable online high-score tables that allow for team competition between classmates, classes or even schools. Each player can customize their workers' identity by choosing a nickname, the color of hair and clothes and skin tone.

5. Learning while having fun: analysis of the players' satisfaction

The use of participatory methods highlighted the importance of taking into account the point of view of students and teachers on the game's effectiveness. Students who tested the beta and final version of the game were asked to complete a survey on user satisfaction, which also allowed them to express any critical comment on the usability and content of *Sicuri si diventa*. In the course of different real-game events we also conducted direct observant participation to collect more data on gaming practices and team play. These results were then shared and discussed with the game developers in order to use our observations to improve the game's features according to the students' feedback.

The beta version of the game, which included only the agricultural sector, was tested in three schools with a total of 49 students: 6 out of 10 players expressed a «positive» evaluation of the «fun» side of the game and 8 out of 10 judged it «appropriate» and «useful for learning the principles of safety at the workplace». Some criticism was direct «repetitiveness» of the game, mostly associated to the presence of a single work environment, but also to the length of some of the text, which was later edited and made easier to read and absorb. 96% of interviewees were satisfied with the characterization of the junior health and safety manager, although some of the players reported that they found the role 'challenging'. However, most of them found that the game was useful to become more aware of risks at the workplace and to learn prevention rules. For example, comments reported that the most important takeaway for them had been «understanding that the first aid kit must always be available», or that «it is fundamental to use the correct personal protective equipment (PPE) at the right time», or «which PPE can protect from chemical risk». Other significant suggestions emerged from the survey include:

- Add the possibility to play off and on line;
- A wider set of choices for character customization;
- Make players even more autonomous in their choices;
- Include death or a «game over» scenario in the narrative.

Most of these suggestions were built into the game and allowed us to improve it. However, we deemed preferable to replace the possibility of the workers' death with injuries that are caused by mistakes in the use of PPE and that force characters to stop and lose work (and play) time in an infirmary.

The completed version of the game, which included all three work environments, was presented at a national health and safety expo in Bologna. *Sicuri si diventa* was tested by 75 students who had never been involved in the research and who were asked to fill in a survey similar to the one used for the beta version of the game. The results revealed an even higher level of player satisfaction among the students: while in the first group for the beta test only 46% considered the game «appropriate» and 31% defined it as «fun», 90% of the second group – who played the final version of the game – gave a positive answer to the question «Did you like playing with *Sicuri si diventa*». According to this second group of students, the game is especially useful for learning while having fun (94%) and for acquiring awareness regarding risks in the workplace (86%). It also helped the players remember some of the rules of health and safety (83%), in particular those concerning the uses of individual safety equipment, which play a key role in the game narrative (figs. 5-6).

FIG. 5. *Did you like playing with Sicuri si diventa? (%; N=75).*

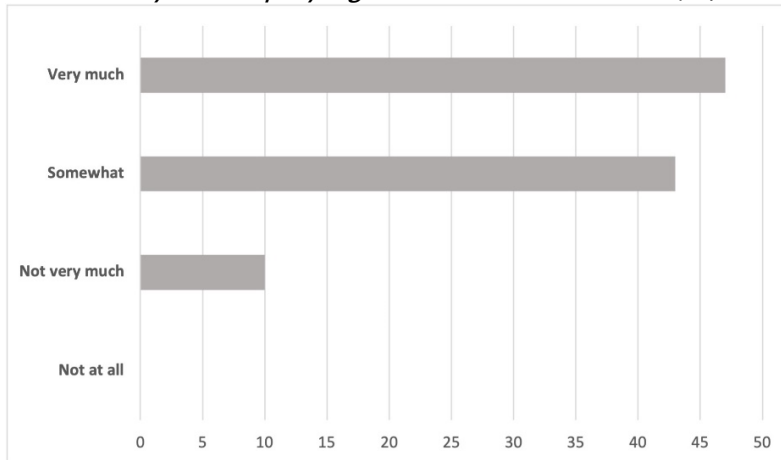
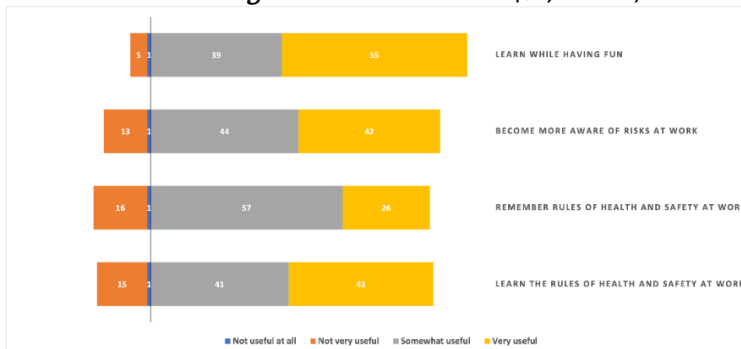


FIG. 6. *This video game is useful to... (%; N=75).*



Conclusion

Even within structured/formal education programs, video games and especially serious games can provide a chance to co-construct content and knowledge: players have the opportunity to experiment with irony, team-working, mutual encouragement or critique. While always remaining aware of the 'playful' nature of serious games, we can stimulate creativity and learning-by-doing through practices that are already familiar to young people. Games, as the corporate world has already discovered, are extremely helpful for the improvement and practice of transferable soft skills, so much so that after having been labeled as unproductive, they have been reclaimed as strategic tools to introduce the dimensions of affectivity and emotions in the workplace. Still, schools seem slow to catch on to this shift in perspective: while corporations invest money and resources in projects and training based on the idea of gamification, the school system, especially in Italy, has yet to become fully aware of the wide range of possible applications of video games for education.

Our research project was designed in this ambivalent context, where video games for young people are from time to time celebrated or condemned, aware that «like all technologies, video games can be good, bad, or indifferent: It all depends on how they are used » (Gee, 2014). From the perspective of our research framework, gaming and gamification as educational tools should neither be idealized, nor stigmatized as instruments born out of fleeting fashion and the entertainment market in the society of spectacle criticized by Débord (1967; Bassetti et al., 2017). The challenge posed by this project concerns, more than the effective learning of notions and rules facilitated by these digital tools, the idea of extending the opportunities to learn, e.g., to facilitate the construction of critical awareness about risks for health and occupational accidents, while accepting to agree about taking advantage from prevention. Therefore, we based our research on participatory methods aimed at co-creating a serious game, engaging all the different actors involved in education on occupational safety: students, teachers, health professionals, and technicians.

Our idea is that dialogue and interaction among these actors can help improve communication and therefore facilitate gaining the appropriate skills, since a preliminary sharing of perspectives is crucial to identify problems and their solutions. Even though so far, several studies found no significant differences in academic achievements by digital learning or even serious games, it is still meaningful that «significantly more positive attitudes toward serious game assisted learning were revealed compared with traditional paper-based learning» (Zhonggen, 2019), since they encourage active participation and team play.

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