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Becoming safe: a serious game for occupational safety and health training in a WBL Italian experience

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Abstract. Through the work-based learning (WBL), students carry out part of their formative curriculum into working contexts, so that the traditional learning, linked to the individual disciplines, is renovating into a new path that includes informal and non-formal competences. Technology is progressively more used to support innovative teaching that allows young people to acquire new skills to meet the needs of the changing labor market. The study describes a participative research and co-design work realized into seven Italian high schools of the agricultural, construction and manufacturing sectors, to co-create an educational tool (videogame) in order to promote occupational safety and health (OSH). The study applied qualitative and quantitative methods to facilitate the participation and the engagement of teachers and students. Learning by playing has always been an activity, today technologies and gaming can offer cognitive and operational elements suitable for recognizing and therefore preventing the occupational risks.

Keywords: serious game, occupational safety and health, work-based learning.

1 Introduction

In 2018, in Italy, 16.3 millions of people (aged 6 - 64) played videogames: the 37% of the Italian population (in particular 54% men and 46% women) [1]. Most players are between 15-34 and 45-64 years old [2]. Videogames brought in revenue of 1.7 billion in 2018, with a growth of 18.6% from the previous year observe, although 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 [3]. But some studies consider the benefits that videogames could have in several domains: “cognitive (e.g., attention), motivational (e.g., resilience in the face of failure), emotional (e.g., mood management), and social (e.g., prosocial behavior)”. Games and play have a special quality of social bonding “providing context and motivational aspects that can be used to improve the dynamics and solutions” [4]. Moreover, an increasing

number of serious games applied in education are emerging [5]. Easiness of use, elements of surprise in the story-script, open-ended situations have been found as influential factors for the effectiveness in learning outcomes, especially among young players [6, 7].

The OSH Community strategy 2007-2012 [8] considers the prevention culture an important area of action: the purpose is to ensure that students receive risk and OSH education as part of their general education before they start working [9]. A recent study of the French National Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS) found that for young workers who received OSH teaching at school, the occupational accident rate was 50% lower than for young workers who did not [10].

2 Materials and methods

Starting from international and national literature' review, a participative research and co-design work into 7 Italian high schools – agricultural, construction and manufacturing sectors – was realized to co-create an educational tool (videogame) in order to promote OSH during the WBL programs. This study applied qualitative and quantitative methods:

1. qualitative inquiry through individual interviews and focus group discussions in 4 Italian high schools (12 teachers and 60 students);
2. survey by questionnaire (277 students);
3. four word cafés/focus groups (50 students);
4. ten semi-structured interviews;
5. three WhatsApp groups (12 students) to facilitate the teachers and students participation and engagement.

A beta version of the serious game was tested with 49 students, than a first competition – to encourage the team participation – was organized with 75 students of two Italian high schools. A user' survey, about the satisfaction and commentaries on the videogame, was done by a questionnaire addressed to those 75 first players and by direct observation of their team gameplay. The final version of the videogame, adjusted following the observational and quantitative findings, was realized and tested by a game competition and final award among 39 students of 2 different schools (one of which participated from the beginning of the project).

2.1 The aim study

In Italy, the paths for transversal skills and orientation (PCTO) are promoted by schools for transversal activities to enhance the formative value of on-going orientation: the focus is on the educational value of the concrete work experience [11]. It is an opportunity to promote WBL paths, which encourage young people to have work activation processes and conscious social identity [12] since the alternation between work and study uses everything' student to acquire skills in the work context which will then be redefined and systematized at school [13].

This study, realized in collaboration with the University of Bologna, was financed by the National Institute for Insurance against Accidents at Work (Inail) through the BRIC 2016-2018 call¹. In our study' framework the game is considered neither as an idealized way of doing digital education, nor as the stigmatized instrument contributing to the contemporary fashion of gamification and the entertainment market in the society of spectacle that was the object of Débord's critique [14,15,16]. The challenge more than in the structuring of educational contents is in the amplification of the opportunities to learn, e.g. to facilitate critical awareness about OSH risks, accepting the possibility to agree about taking advantage from prevention. A methodological path was designed, aimed to co-creating a serious game, engaging all the different actors of OSH education: students, teachers, OSH experts. No significant differences in academic achievements were found between digital learning and serious game use, but it is meaningful that "significantly more positive attitudes toward serious game assisted learning were revealed compared with traditional paper-based learning", since they encourage participation [5].

2.2 The participative process

The participative process of co-creation [17] follows the following steps:

- a qualitative inquiry in 4 Italian high schools – in 3 different sectors: agriculture, construction and manufacturing – to engage 12 teachers and 60 students in individual interviews and focus group discussions about their representations of risks in general and in the workplace and their learning and teaching experience;
- the creation of a smaller voluntary group of 12 students considered as "peer ambassadors", who had the task to make other interviews to their friends and other acquaintances and to interact with researchers (face-to-face and via instant messaging platforms) about the videogame design;
- a quantitative survey, in collaboration with the health experts, addressed to 277 students (63% boys and 37% girls) of the last three years of the 7 high schools, in order to deepen and verify the knowledge of their representations of risk and learning activities on safety, and evaluate their gained skills in risk prevention;
- a preliminary design of a serious videogame on OSH based on the analysis of the main findings to realize the beta test (a first questionnaire was submitted to 49 students of 2 high schools matching with the teachers and the OSH experts);
- the development of the videogame "Sicuri si diventa"² (Becoming safe), in collaboration with the developers of a software house, who were invited to participate in the beta test as well;
- the organization of a first competition encouraging team participation, with 75 students of 2 high schools and a user survey about the satisfaction and commentaries on the videogame, through a questionnaire addressed to those 75 first players and by direct observation of their team gameplay;

¹BRIC is a two-years research project in collaboration with University, public research center and other public health intuitions financed by the National Institute for Insurance against Accidents at Work

² www.site.unibo.it/sicuri-si-diventa/it/gioca

- the final version of the videogame, adjusted following the observational and quantitative findings, with a game competition and final award among 39 students of 2 schools, one of which participated from the beginning of the project.

2.3 The video game “Sicuri si diventa” – (Becoming Safe)

This study is the result of a participated process that actively involved high-school students in the design of the gameplay mechanics as well as in making the main decisions regarding its educational contents. It was realized in collaboration with a team of developers and designed as a learning tool and a support to mandatory training, to be used in and out the classroom, developing a good practice for OSH culture in accordance with technical and legal issues. The goal is to win a race against time to prevent accidents, protect workers and build a safe workplace. The structure of the game encourages entertainment and interaction to actively engage the players' agentive behaviors. The game is suitable both for individual and team play and therefore can be played cooperatively or competitively. It can also be played on different devices (PCs, tablets, smartphones).

“Becoming safe” 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 3 different work environments – agriculture, construction and manufacturing – graphically translated in the style of some of the most popular videogames 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 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 OSH manager, initially guided by a senior manager who explains the basic rules and regulations that have to be followed to guarantee the workers' health and safety. By enhancing safety and preventing accidents, the safety manager ensures the mental and physical wellbeing of the workers and eventually helps the company become more successful and grow in terms of number of workers and overall production. 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 OSH rules inevitably involves a loss of time and money both for entrepreneurs and workers. Therefore, the game includes progressive incentives and prizes, but 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 a role-playing game context – where the player has to drag and drop objects and tap or click to use them.

3 Digital as opportunity for education and OSH training

According to the guidelines – art.1 paragraph 785 of the Law n.145/2018 – despite the specific didactic and training purpose and the limited presence and exposure to risks, the students acquire the status of workers pursuant to article 2, paragraph 1, letter a), of

Italian Legislative Decree 81/2008 [18], and therefore they are subject to the obligations required by OSH legislation as training, health surveillance and individual protection devices [19, 20].

3.1 Digital opportunities and skills needs

Today digital skills are a prerequisite to fully participate in the labor market, but benefiting from digital opportunities depends, first, on meeting some skills requirements, and second, on operating in a safe digital environments. These skills include pure digital skills but also the emotional and social skills. Possessing this mix of skills, conveniently labelled as “digital literacy”, is a pre-condition for people to harmoniously combine their digital and real lives, and to avoid the mental health problems associated with abuses of digital technologies [21]. Three types of skills needs have emerged in the context of the digital transformation: a) ICT problem-solving skills as well as solid literacy, b) numeracy and problem-solving skills; specialized skills (i.e. cloud computing, big data analysis, block chain and AI are reliant on highly specialized skills); c) additional skills that are complementary to digital technologies, such as creative, social and emotional skills [21]. In the workplace, interpersonal and leadership skills, as well as the ability to navigate and leverage the digital economy, are also becoming more important [22].

3.2 Digital divide and education

In this context, besides offering new pathways for learning, schools play an important role in bridging the digital divide and ensure that all children reap the benefits of technological advances. Digital resources in the classroom can serve as an equalizing force between students who do and do not have access to digital technologies at home, allowing the latter to catch up with the digital mastery of the former. The results of digital learning experiences in schools are somewhat mixed, and many studies report limited or no benefits of digital education [23, 24]. This negative effect may be the result of greater distractions in the classroom, when students use Internet connection for chatting or playing rather than learning [25]. Another way digital resources may not necessarily be conducive to improved learning outcomes relates to the lack of digital skills of teachers, in fact, when they are not familiar with digital technologies, digital resources can form a distraction for both teacher and students [21].

4 Results

The main interpretative frames [26] resulting from the focus groups concern: 1) Need to work then to risk; 2) Earning money, which involves accepting risks; 3) The challenge with oneself and with other people; 4) Experience which can but is not always useful to avoid risks; 5) Fate, e.g. “we cannot prevent everything”, anyway a minimal distraction or malfunction could make knowledge useless. In fact, interviews suggested that risk at work is often associated with the need to save time, to save money and, consequently, to maximize a company’s and 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 accident, 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 workers' health.

The findings of the survey confirm these trends, especially the strong association between risk, getting hurt (30,3%), fate (28,9%) (e.g. the unexpected events) and lack of attention (27,4%). These aspects are underlined also in other control questions linked to the risk situation, where the lack of attention is considered the first most dangerous risk event, followed by rush, convenience and habit. Partially different results arise from qualitative and quantitative data concerning the students' evaluation of the effectiveness of OSH training at school. While a small percentage of the students (21.7%) who attended safety courses generally state that they have been useful, in the focus groups students explicitly point to the excessive abstraction of "boring power point presentations", as opposed to direct experience. But, when the questionnaire requires to rank six forms of training (from most to least effective), almost half of the respondents indicate "direct experience" as the most effective form for OSH training, while 39.2% think that traditional lectures - like the ones they are required to attend at school during institutional training - are the least effective.

5 Conclusions

In a rapidly changing world, education and training are called upon to play a key role in the acquisition of skills and competences useful for seizing the opportunities that arise in anticipation of changes in society and in the world of the labor market. In this context, digital technologies can unlock new learning opportunities in the classroom by giving students access to a wider range of resources, by complementing the teacher in learning processes (computer-assisted learning) and by providing other advantages to students, such as access to motivational and informational resources associated with access to tertiary education programs. Learning by playing has always been an activity, today technologies and gaming can offer cognitive and operational elements suitable for recognizing and therefore preventing the occupational risks.

This study confirms that educational elements can be integrated into a gameplay, so that will be subconsciously acquired by the players during the gaming process. The results of the survey, in fact, show a high level of player satisfaction among the students: while in the first group for the beta test only 46% considered the game "adequate" and 31% defined it as "entertaining", the 90% of the second group – who played the final version of the game – love playing with it. According to this second group of students, the game "Becoming safe" is especially useful for learning while having fun (94%) and for acquiring awareness regarding risks in the workplace (86%). It also give the possibility to better remember the OSH rules (83%), in particular those concerning the uses of individual safety equipment, which play an important role in the game narrative.

This path could be a support for training and usable both in the classroom and in internship, according to the indications for the serious game's design. Evidence suggests that educating individuals to become more flexible, resilient and creative and to pursue personal wellbeing helps them to adapt better to the changing work and life environment [27]. Interactive teaching practices, for example the problem-based learning (PBL), require students to work in groups and use non-cognitive skills in their discussions, to listen to one another when solving problems, or to make choices about their own learning [28]. PBL can contribute to developing a student's cognitive skills [29] and, together with interdisciplinary learning, can facilitate the acquisition of non-cognitive skills by emphasizing the importance of flexibility and innovation for the OSH issues too.

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