Serious games for serious challenges: a transdisciplinary study to change obesity prevention at primary school

Serious games per sfide serie: uno studio transdisciplinare per cambiare la prevenzione dell'obesità nella scuola primaria

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L'articolo esplora i cambiamenti emergenti nella pratica educativa in relazione ai concetti chiave sui serious game, considerando il potenziale che questi offrono per un cam- biamento paradigmatico verso un approccio di apprendi- mento attivo e potenziato dalla tecnologia. Viene presen- tato il progetto pilota di una ricerca transdisciplinare sulla gamificazione della prevenzione dell'obesità a scuola, sulla base del lavoro avviato nell'ambito del Centro di Ricerca Telemedicina dell'Università di Bari, che attualmente si sta occupando di esplorare il potenziale del digitale per innovare l'educazione alla salute e l'evoluzione dei serious game, da applicazioni per singoli utenti ad applicazioni coinvolgenti che connettono i giocatori e utilizzano sensori indossabili. Nell'ambito di un approccio multidisciplinare che include conoscenza, forma fisica e benessere psicoso- ciale, questo progetto sperimenterà un serious game sull'educazione a un'alimentazione sana progettato per i bambini della scuola primaria utilizzando un robot sociale nell'ambito di un ambiente di apprendimento collaborati- vo.

Parole chiave

Serious games; educazione alla salute; apprendimento ba- sato sul gioco; robotica educativa; prevenzione dell'obesità

The article explores the emerging changes in educa- tional practice in relation to serious games key criti- cal concepts, considering the potential that serious games offer for a paradigm shift towards an active and technology-enhanced learning approach. The pilot project of a transdisciplinary research on game- based obesity prevention at school is presented, based on the work started within the Telemedicine Research Centre at University of Bari, currently ex- ploring the potential of digital health to innovate health education and the evolution of serious games from applications for individual users to engaging applications connecting players and using wearables. Within a multidisciplinary approach including knowledge, physical fitness and psychosocial well- being, this project will test a serious game on educa- tion to healthy eating designed to be played with primary school children using a social robot within a collaborative learning environment.

Keywords

Serious games; health education; game-based learn- ing; educational robotics; obesity prevention

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Introduction

Play is an element that accompanies the person throughout the course of life. Already in his *Homo ludens*[2], Johan Huizinga wrote

> "The existence of play is not tied to any degree of civilization, to any conception of life. Every thinking being can immediately represent that reality: play, playing, as something specific, independent, even if his language did not have a general expression for it. Play is undeniable. Almost all abstractions can be denied: justice, beauty, truth, goodness, spirit, God. Seriousness can be denied. But not play."

Although sometimes unconsciously, as it happens for example with children at an early age, play favors and can simplify the learning phase. And it is precisely the playful factor, present in many human activities, that represents the concept on which the development of serious games is based, which can be defined as an ad- vanced methodology that exploits technological innovations by making original proposals to encourage learn- ing.
What has been said makes it clear that this kind of games has an aim that differs significantly from the classic ones, since if for the latter the purpose is only fun and entertainment, in serious games the playful aspect is exploited for entertainment but also and especially for learning. This kind of games uses technology, specifi- cally console games, virtual reality or mobile games, and the concept of serious game should not be confused with that of gamification, as this one simply represents a technique for the creation of typical game situations not necessarily linked to play with final purpose of creating an activity that is performing and not necessarily capable of encouraging learning.
In every playful activity it is possible to identify three factors:

- entertainment;
- simulation;
- learning.

These three elements are closely related to each other, and at the same time one of them can prevail over the others. Specifically, if learning and simulation prevail in the game, specific activities will improve the perfor- mance of the subject concerning a specific behavior. This type of game is widely used among the armed forces (war game) to create a virtual reality to emulate trainings that are safe and at the same effective. If enter- tainment and simulation prevail, what arises is a real simulation; some examples are soccer or fighting games, with aim of developing abilities. If entertainment and learning prevail, games can be productive for knowledge, therefore these ones are used in educational institutions. Finally, if none of the three components prevail over the other, a balance is created that is typical of serious games, as a game is created that pushes the player to get involved in challenging dynamics, to learn strategies and therefore to improve performance and skills.

1. Changes driven by technology-based serious games

The term serious game literally means “serious game”, that is in stark contrast to what this kind of activity ac- tually manages to do. This term was introduced in 1970 by Clark Abt, who argued that games should not be used only for their playful aspect, as hiding much higher potential and certainly including the ability to stimu- late learning. In this sense, the meaning of the term “serious” gains meaning, as it was coined with the inten- tion of indicating serious learning contexts, other than mere entertainment.
Talking about serious games the reference is to the possibility offered by these activities to provide learning experiences simulating reality, thus favoring the acquisition of everyday life necessary skills.
Numerous scientific studies[3] have shown that serious games are able to improve both knowledge and cognitive skills, and can be helpful for the acquisition of motor skills. It has also been observed that the acquisition of

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[2] Huizinga J., Homo ludens, Einaudi, Torino 2002.

[3] Cantu C., *Cooper Interstellar. A serious game system for ADHD children from 6 years old*, Politecnico di Milano, Milano 2019.
Celentano M. G., *Interfacce e sistemi a realtà virtuale per un apprendimento esperienziale,* in "Giornale Italiano della Ricerca Educativa", 4 (2014), pp. 21-33, Pensa Multimedia, Lecce 2014.

skills is linked to the correct balance between various game parameters (modulation of game difficulty, type of stimuli, presence of feedback) and it is for this reason that before starting an initial test is always recom- mended to assess the player's starting level. This is also justified by the fact that this game mode assumes a great stimulation of the neuropsychological component, so aspects such as attention, motivation and percep- tion are all more excited and motivate the player to reach the set goal; therefore the game parameters must be “calibrated” on the player otherwise they risk being demotivating.

The real strength of serious games is the ability to keep the players’ attention level always high or at least at a level that is not demotivating. In this sense, attention can be defined as the cognitive function par excellence, being able to strengthen all the other components, thus managing to maintain the level of motivation always elevated for the purpose of achieving the goal. This highlights the importance that both attention and motiva- tion go hand in hand without ever being too low or too high for the expectations of those playing, otherwise in both cases there is the risk of giving rise to the feeling of frustration and consequently demotivation of the player.

One aspect that has been revealed is the absence of a judge sentencing the player's failure to achieve the set goal, as the only one to establish whether or not he has managed to reach the goal is a simple software, which minimizes fears, anxieties or stress.

Finally, a further aspect that should not be underestimated is the reward system that is used in this activity, that is both rewarding and providing feedback, as it is supposed to stimulate motivation to continue playing and keep the player level of attention high. In this way, a well-designed game from a cognitive point of view can stimulate learning especially concerning strategies that allow to continue the game and at the same time these dynamics can also be useful in real life.

Technological innovation has led to the birth of serious games, games based on learning understood as the ac- quisition of knowledge, skills and competences in an active and participatory way. This involves an interaction made up of continuous information exchanges between the person and the surrounding environment, and for this to happen it is necessary that the person owns the necessary skills. This is why life skills are fundamental; they must be understood as a set of essential skills capable of supporting individuals in the process of adapting to the surrounding environment, both daily and professional, establishing positive attitudes in order to support and effectively deal with the situations offered by the environment itself. In them it is possible to find social, communicative and expression skills, therefore, behaviors and attitudes that manifest themselves both on an individual and relational level, and which can be strengthened through experience. It is in this direction that serious games operate. They manage to interest five large cognitive areas: attentive, decision-making, memory, motor and linguistic without accusing fatigue or stress for those who use them.

By taking advantage of this game mode, it is possible to affect multiple areas. Concerning the health field, these are mainly used by doctors to train in environments that simulate what they will actually have to do, avoiding unnecessary risks / damage to patients. Furthermore, scientific research has shown that these are able to produce beneficial effects even on patients during interventions. For example in some patients who report- ed severe burns, instead of administering anesthetics during the change of gauze, serious games were used to reduce pain, and it was found that it reduced pain from 30% to 50%, thus managing to replace drugs such as morphine whose action is very powerful. All this was possible because the patient's attention was shifted to- wards the game and not to the perception of pain.

Another area in which serious games are beginning to be widely used is that of school, specifically, it has been observed that, for children who are affected by attention and hyperactivity disorder (known by the acronym ADHD), 30 minutes of play per day for five days per week over the course of a month, about one third of children no longer exhibit attention deficit on at least one objective measure of attention.

Another game that assumes great importance for today's generation stimulates the ability to recognize fake news, an aspect that should not be underestimated given that even today the majority of the population that uses the web is not able to recognize a true news from a false one.

Another area in which serious games can be used it is certainly the world of work, specifically some companies use this method to select the candidates to assign the job, others still use them as internal training or to simu- late business environments.

These examples have highlighted how this innovative game modality is based on the development of new knowledge, on training new skills, on the modification of dysfunctional behaviors and on the development of cognitive skills.
Finally, we must not forget that in them there is always the premise of failure, whose task is to create chal- lenges that encourage players to always use a growing commitment, and therefore a greater stimulation of learning.
Theresa Fleming in 2017 identified and classified six serious game modes:

- Exergame: that is games that are based on movement, and are especially effective for people have depressive symptoms occurring;
- Biofeedback: that is, games in which the participants try relaxation exercises, while receiving synchro- nous messages relating to their state of physiological arousal. For this reason, the feedback is a tool able to regulate itself with greater simplicity in the activity carried out;
- Computer games: that is, games that allow to reduce the symptoms deriving from mood disorder;
- Virtual and augmented reality: that is games that allow through virtual reality to guarantee sensory stimuli, as well as auditory and visual ones. Their effect on those who use them is the sensation of reality that they are able to transmit;
- Games calibrated on cognitive-behavioral therapy;
- Cognitive training games, that is able to train the player to cognitive maintenance, in order to cope with the effects of deterioration.

2. Learning by playing serious games

Video game was created with the aim of entertaining and amusing those using it. Subsequently it develops and expands its range of action by establishing a new goal: to teach something to those who are playing. This is the case with serious games. Undoubtedly, to achieve this it was necessary for the educational-training area to approach that one of technological innovation.
The use of video games in order to learn something has numerous advantages thanks to the characteristics that are inherent in these tools and that allow to effectively apply learning by doing. Serious games therefore become an excellent tool to learn theoretical notions and subsequently experiment and put them into practice several times until they are mastered. This mode is usually used above all by people of not advanced age, be- cause in them there are attracting characteristics: intuitiveness and playful factor.
The great advantage provided by this form of learning is precisely the ability to “hide” study, a form of activity that usually does not attract many young people. Everything is further masked by the competition that is cre- ated both with oneself and with other players, thus managing to maintain the right level of attention and mo- tivation.
This highlights how serious games are not only useful in relation to school activities but also as training tool whose interaction and feedback between game and players manages to stimulate attention in a continuous way. By doing so during the learning process the players becomes an active part of it, as they learn through their interaction with the game, and as an aspect not to be underestimated, at the same they consolidate what have learned by playing.
Among the modalities that are used by serious games to be able to keep attention and motivation at the right level there are certainly some factors of the game such as sounds or graphics able to involve the players from an emotional point of view, so succeeding to create the right empathy / attraction between the game and the player. Furthermore, these aspects allow those who use them to immerse himself in the game in the most complete way, which will be of fundamental importance to ensure that effective learning takes place over time.
Another aspect that must be given due consideration is certainly the feedback that the game returns to the players, and through this it is possible to understand their level of learning. There are different types of feed- back in serious games, from the score that increases according to the correct actions, to the achievement of specific goals, to access to experiential reward content. Choosing the right feedback for learning purposes is of fundamental importance: several studies have shown that simply continuing the game as the score increases is not of great help for learning.

Serious games have been taken into great consideration and exploited by the educational-training field be- cause they allow a form of active learning, as the game approaches reality, so that the players, in order to ad- vance of level, are forced to face what it is, even though through play, real life. Therefore, a serious game must be able to propose a game environment that is as similar as possible to real situations, in order to allow the players to learn and at the same time apply what they have learned while playing, and it is for this reason that factors such as graphics, sound or game dynamics are as real as possible.

Serious games are not only used in the school world, but thanks to their great capacity and simplicity of diffu- sion they can be exploited in many other sectors. They are also used in the world of disability, as through play it is possible to satisfy a desire to "do something" that at that moment it is not possible to do or manage a pa- thology simply because it has been done positively in the virtual game. For example, there are games whose aim is to stimulate awareness of the importance of chemotherapy in defeating the tumor in pediatric cancer patients. Specifically, it manages to combine the desire to achieve this outcome in reality with the player's ability to kill cancer cells with chemotherapy weapons. Furthermore, scientific research has shown how the correct use of this serious game produces better adherence to oral chemotherapy.

There are various and multiple forms of games, each with its own peculiarities but all with a single common thread: learning, and in a society that is moving towards an increasingly interconnected world, there is a need to think about innovative tools to face an increasingly complex reality that is evolving following non-linear tra- jectories. It is for this reason that it is important to be able to create a productive way of thinking for learning purposes.

This innovative educational method exploits the playful component inherent in the game to promote learning and aims at simplifying and making as real as possible the educational content in the form of a game, to en- sure that what has been learned becomes useful for improving certain skills and knowledge of the player. This demonstrates how the link between serious games and learning can now be considered rooted and insepara- ble.

The substantial difference between a classic learning process and one that uses serious games lies in the ability to attract the interest of the player / pupil in the complexity of this procedure which, however, does not ap- pear as that in the eyes of the player.

Furthermore, we must not forget that the instructions for accessing or playing are rarely consulted, precisely because those who play prefer to do it "on an adventure", which implies activating a wisely controlled learning process that generates a sensation of overcoming difficulties, which is essential to keep interest in the game alive.

The concept on which video games are based is identical for all and is based on two indicators: learning and difficulty. In every moment of the game the players' level of learning

allows, by demonstrating a minimum of deduction and mental agility, to cope with the difficulty of the mo- ment, and when they manage to overcome it, they acquire new knowledge and must cope with a level of higher difficulty which, again, force to overcome oneself. Conversely, if they fail to go beyond those difficul- ties and therefore lose too often, the game itself provides help to overcome that level, in order to avoid creat- ing too much disinterest and demotivation.

This game principle ensures that the player remains constantly focused on the game, resulting in a profoundly engaging and educational experience.

3. Technology and serious games at school

For decades teaching and learning has been based on the idea that the teacher, as an expert in a particular subject, must expose his knowledge to a student, who simply has to learn in a notional way. This learning mo- dality requires the learner to limit himself to acquire knowledge in a passive way, which could affect the learn- ing itself, generating a pattern of automatic and sterile repetition of the transmitted contents. This form of learning, even if still rooted in the school context, must make way for another form of teaching-learning in which the learner is placed at the center in order to participate and be an active part. From this point of view, technological innovations, known in the school world as ICT, are of great help, and in recent years serious games have also had great importance, with a pedagogical model mainly based on experiential learning. They are characterized by an active acquisition of information by students, who make use of the interactive experi-

ence requiring a high degree of participation to make the appropriate choices and be able to reach the pre- established goal.

The value of this training method is undoubted, as thanks to the ability that these technological systems have to faithfully reproduce reality, a natural process of learning by doing take place. That is, through actively living training experiences that favor a better internalization of the lived situations and the experienced sensations, learning takes place with greater simplicity and without the sensation of stress or fatigue because a greater personal involvement lies at the basis.

This new learning method certainly does not exclude the role of the teacher, since when the learning experi- ence is over, the teacher must direct the analysis / reflection on choices and actions and intervene when any difficult situations that temporarily make lose sight of the training objectives arises.

Teachers, whose average age is several times over 50 years old, initially showed an attitude that was not exact- ly favorable to the introduction of new media in the school context. Subsequently, due to continuous training on technological innovations and to the advent of the Covid-19 pandemic which forced all members of the school to learn and understand the importance of using technology at school, many teachers have radically changed the idea on serious games, enhancing the playful aspect, capable of "simplifying" the educational processes, as the goal of winning the game must necessarily involve the acquisition of inherent training con- tent in the game itself.

Serious games have been designed and structured also and above all to affect the emotional and social sphere, with the idea that testing positive emotions and prosocial behaviors as collaboration, respect and tolerance will lead to use them throughout life as part of one's own identity.

Technology is ubiquitous nowadays, so video games, as well as smartphones or computers, are present in al- most all formal and informal learning environments. From this point of view, the school must have the objec- tive of training young people in order to make them protagonists aware of their future and of the society in which they live. Therefore, educational institutions need to understand and adapt to students' new mental pat- terns to enable more effective learning. Students now prefer exclusively forms of learning in which they feel an active part, and during their "doing" they accept the error, seen as a point to start again. From this point of view, serious games can fully satisfy learners' needs, as they make it immediate and simple to find the infor- mation necessary to overcome the obstacle that previously led to failure. Therefore, they can learn immediate- ly from the made mistake, correct it, and instantly learn the appropriate behavioral model for solving the prob- lem.

The advantage that is provided by serious games in the learning phase at school is certainly the students' moti- vation, as learning is not placed at the center of the playful activity but occurs effectively as a sort of side ef- fect. All this is possible because the student can both acquire skills and apply them in a protected context that faithfully reflects reality. Moreover, thanks to the use of this innovative methodology, the difficulties of con- centrating during a lesson are almost completely eliminated. Scientific studies have shown that students with specific learning disabilities made progress within the game, as a protected place with no external intrusions, thus avoiding factors such as anxiety or stress.

A well-designed serious game can satisfy needs that go far beyond the simple game. It can train / teach a spe- cific topic, encourage social interaction, stimulate real contexts, propose a form of physical activity, all this managing to satisfy the needs for growth, activity, self-esteem, and maintaining high levels of satisfaction and interest. Therefore, they become real places where it is possible to "train" to learn. This highlights how this innovative learning method is well suited to the new generations of digital natives who manage multiple ac- tions at the same time and navigate in different dimensions at the same time.

Educational institutions must not limit to welcoming digital innovations, including serious games, but have to review teaching methods, structuring an environment in which learning is real and takes place by trial and er- ror, and this must be intended as an integral and necessary part for it to occur. It is in this perspective that se- rious games show their strength. They are able to simulate reality and create a learning environment in which, thanks to play, learning is nothing more than the progressive acquisition of awareness of the error. Therefore, these tools can be considered to all intents and purposes interactive and at the same time educational, in which the student can get involved, alone or in a group, in simulations of critical situations.

When it comes to learning, we must never forget the importance of assessment. It takes place in various ways and at different times, and the introduction into the formative-educational process of the pupil has also brought about a change in the evaluation process. Correctly evaluating what has been learned and assimilated

accurately means being able to verify the progress obtained by the learner and understand if he has developed a critical thinking on what has been learned.
While traditional assessment tended to detect knowledge especially in the final phase of learning, with the use of serious games it is also possible to carry out an ongoing assessment, thanks to the introduction of scores and feedback indicating the correctness or inadequacy of the done choices. Thanks to it, it is possible to carry out an analysis of learning throughout the process, thus managing to highlight emerging difficulties. Further- more, the possibility that the student has to independently correct his behavior and consequently modify his decisions during the game should not be underestimated according to the achievement of the objective. Therefore, it is possible to say that a synergy is created between learning and assessment and both need the other to be able to avance "game level", meaning that the student is inevitably learning new knowledge, skills and competences useful for everyday life.

4. School-based serious games for health literacy and obesity prevention

As the covid-19 pandemic is providing ongoing challenges for health behavior changes, serious games are cur- rently being assessed to overcome "health literacy" barriers using game mechanics. Addressing the covid-19 pandemic requires indeed health literacy[4], asking people to rapidly acquire and use public health information in order to modify personal behaviors, recognize which information is trustworthy and which is not and apply it in a meaningful way while recent study found yet that health literacy in Europe is relatively poor with 47% having limited or insufficient health literacy, especially for subgroups related to financial deprivation, low so- cial status, low education, or old age[5]. The disinformation/misinformation/fake news triad is highlighting the need to help children and adolescents distinguish between reliable and unreliable health information and pro- mote health literacy[6]. The Seventh Nairobi Conference on Health Promotion (2009), already emphasized health literacy as a form of empowerment and pillar of a holistic approach to health promotion, highlighting the triangulation of empowerment, health literacy and information-educational processes as the foundation of a modern citizenship. In the present social scenario, in particular, digital health literacy becomes a fundamen- tal tool to manage the overload of information available through digital communication channels; this is par- ticularly important for children and adolescents, who spend many hours on the Internet and on social media, as sources of health information and knowledge.
Therefore, health education, meant as community-based approaches to health overcoming the traditional medical model with aim of students' engagement and empowerment, becomes fundamental to strengthen health literacy among students and school staff incorporating health and sustainable development in 'future- oriented curricula'[7]. According to OECD value-centered curricula must strengthen health education with re- formulations emphasizing individual self-determination resources, investigative skills, critical thinking and problem solving, with an emphasis on personal and social responsibility and, at the core foundation of the cur- riculum, health and well-being are linked to knowledge, attitudes and values with aims of quality of life.
Health related serious games, aiming at promoting navigation health literacy as non-clinical interventions for adolescents, are arising at the intersection of schools and communities with intervention foundation lying in a socio-ecological understanding of health and in the entertainment education approach of game-based learn- ing. The game dimension allows the acquisition process to be more engaging, while technology helps to pro- mote and enhance the physical and cognitive perception of the game[8]. Present trends in education supporting playful learning for health globally highlight a pedagogical shift towards co-designing and co-creation process

[4] J. Zarocostas, *How to fight an infodemic*, «Lancet», vol. 395, issue 1025, p. 676, 2020.
[5] Paakkari L., Okan O., *COVID-19: health literacy is an underestimated problem*, «The Lancet Public Health», Volume 5, Issue 5, Pages e249 - e250, 2020,
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[7] OECD, *Curriculum (re)design. A series of thematic reports from the OECD Education 2030 project*, OECD Publishing, Paris, 2020.
[8] Castellano, G., De Carolis, B., D'Errico, F. et al. *PeppeRecycle: Improving Children's Attitude Toward Recycling by Playing with a Social Robot*. Int J of Soc Robotics 13, 97–111 (2021). https://doi.org/10.1007/s12369-021-00754-0.

involving adolescents, community stakeholders and design professionals, personalization of interventions, and just-in-time adaptation using data from wearable devices[9].

Promoting 'obesity health literacy' as capacity building on causes and impact of this chronic disease is a disrup- tive challenge of international institutions[10] as chronic diseases have reached pandemic levels and childhood obesity has become a global public health issue[11]. Obesity as a chronic disease significantly influence the state of health of the population: it is among the main factors that determine the onset of non-communicable dis- eases (ischemic heart diseases, stroke, arterial hypertension, diabetes, etc., so-called non-communicable dis- eases) which are the leading cause of death worldwide an entail a high cost in terms of healthcare. Accentuat- ing the impact of the disease, stigma and prejudice are often linked to this condition, as results of the low ad- herence to the prevailing aesthetic model (in this sense we speak of weight bias to indicate discrimination at school and on work) soliciting inclusive interventions with attention to psychological and cultural dimensions. As the ultimate goal of educational health games is a behavioral change in patients with obesity, digital health interventions appear the most practical modality for behavior change interventions being adolescents digital frontrunners and early adopters of technology. Considering the use of technology by children, research is ex- pressing interest in the potential of these resources to change this population's behavior, particularly regarding childhood obesity[12]. Current research showed that serious games might contribute to tackling childhood obesi- ty[13]. Applying a system approach to large-scale health challenges to implement transformational change, seri- ous health games are currently applied in the domain of obesity as a chronic disease management moving from developing disease-specific topics (e.g., educational games for diabetes) to targeting broader public health topics (e.g., safety and nutrition), entailing a larger coverage of the general healthy population rather than patients with specific diseases and increasing awareness and knowledge among the players[14]. While act- ing directly on uncorrected behaviors according to experts is of little use, producing the best long-term bene- fits in young people are the programs and actions that promote generic psychosocial skills, concerning in par- ticular emotional and social functioning and the adoption of healthy lifestyles. Serious games for health pro- motion are proving to positively influence children's health and promote behavior changes, as well as encour- age healthier habits, representing a powerful strategy for child health education.

In the context of obesity, four types of serious games have been reviewed: the first type aimed to decrease energy intake by improving knowledge concerning healthy nutrition and changing children's attitudes about food (i.e., serious games based on nutrition education and/or dietary change); the second type aimed to rein- force the weight control process and apply nutrition knowledge in daily life (serious games based on executive function training). The third type aimed to provide knowledge, enhance motivation, and encourage behavior change related to healthy eating, physical activities and stress coping (i.e., multidisciplinary serious games). The last type aimed to increase the energy expenditure (i.e., serious games based on physical activity: exer- games)[15]. Increasing physical activity is currently working motivating to be physically active: research found that players who were primed with the intention to use the game primarily for health benefits and who re-

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[9] S.R. Partridge & J. Redfern, *Strategies to Engage Adolescents in Digital Health Interventions for Obesity Prevention and Management*, «Healthcare», 6.3, 70, 2018.

K. Dadaczynski et al., *Promoting Navigation Health Literacy at the Intersection of Schools and Communities. Development of the Game-Based Inter- vention Nebolus*, «Front. Public Health», 9, 752183, 2021.

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[14] N. Sharifzadeh et al., *Health Education Serious Games Targeting Health Care Providers*, Patients, and Public Health Users: Scoping Review, «JMIR Serious Games», 8, 1, 2020.

[15] M. Belghali, Y. Statsenko & A. Al-Za'abi, *Improving Serious Games to Tackle Childhood Obesity*, «Frontiers in psychology», 12, 657289, 2021.

ceived health feedback while playing the game ended up using the exercise game for longer periods of time than other players[16].

5. Research-enhanced obesity prevention with serious games at University of Bari

In the framework of an ecological approach that considers health and well-being as multidimensional concepts including mental, emotional and social aspects as well as a physical dimension, University of Bari is developing an Artificial Intelligence-based study to experiment a serious game to cope childhood obesity and promote healthy lifestyles education.

Considering health education as a life-long learning process within a salutogenic perspective researching for better understanding of positive aspects of human experience and on the basis of positive research results in the fields of educational robotics, game-based learning and computer vision[17], the project intends to respond to the challenge of obesity as growing concern for public health and educational institutions. The choice of this specific population is particularly important considering that the state of chronic inflammation, typical of the pathology under study, represents a factor that predisposes to the development of multiple pathologies leading to death. The multifactorial etiology of obesity, as a disease characterized by a close interrelation be- tween genetic, metabolic and environmental factors, assigns a fundamental role to diet, the implementation of physical activity and the acquisition of proactive behaviors in the direction of quality of life and psycho- physical well-being.

The study is a pilot project of a research-based transdisciplinary project on obesity prevention within the Citel Research Centre on Telemedicine[18] addressing at European level the social challenge of obesity in the field of personalized prevention and artificial intelligence applied to chronic diseases with the mail goals of:

1. better understanding of human health at various developmental stages and correlation to over-weight/obesity
2. provision of food-replacement and nutraceutical solutions to address health and cure needs, including spe- cific needs of people in vulnerable stages of life, people with physical or mental impairments, or groups of population in socioeconomic situations with structural disadvantages;
3. personalized solutions for health promotion and obesity prevention of individuals;
4. development of new digital tools applications and gamification fostering health literacy and empowering citizens to manage health and well-being throughout their life course and to protect from inactivity and misin-formation/disinformation.

In the context of school-based citizenship education meant to promote knowledge and participation of the person in the context with aim of well-being and quality of life, first research questions are: how to make the school experience more inclusive against health inequalities? How to improve lifestyles of students and pre- vent obesity and its complications? How can practices be transformed effectively to support well-being of young people in the context of rapid societal changes?[19].

This multi/transdisciplinary research project, connecting pedagogical tradition, digital innovations and clinical and biomedical knowledge, intends to implement a protocol for the prevention of obesity in children and edu- cation for healthy lifestyles through the experimentation of a serious game aimed at children education on healthy eating. The project will implement and evaluate the use of a social robot as an engaging interface of a serious game designed to promote involvement, collaborative interaction among children and a hands-on ex- perience approach. Serious games represent a class of persuasive technologies that can be effectively em- ployed to promote positive behaviors as a technology that rely even on relational factors like trust and empa-

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[16] F. Laamarti, M. Eid, A. El Saddik, *An Overview of Serious Games*, «International Journal of Computer Games Technology», 2014, 1, 15.

[17] Cfr. G. Castellano et al, *Recycle…*, *op. cit.*

[18] Perla L., Massaro S., *Virtual Patient Education Scenarios: Exploratory Step in the Study of Obesity Prevention Through Telemedicine*. In G. Casalino et al. (eds), *Higher Education Learning Methodologies and Technologies Online*. *HELMeTO 2021. Communications in Computer and Information Science*, Springer, Cham, 2021ù Massaro S., Perla L., *Studio esplorativo sulla prevenzione e cura dell'obesità attraverso la Telemedicina: orizzonti transdisciplinari del lavoro educativo*, In *Ricerca e Didattica per promuovere intelligenza comprensione e partecipazione, Atti del X Convegno SIRD*, Pensa Multimedia, Lecce, 2021, pp. 635- 642.

[19] Massaro S., *Game-based learning nella formazione iniziale dell'insegnante per un'educazione sostenibile alla salute*. In Atti convegno nazionale Si- ped, Lecce, Pensa Multimedia, 2022, pp. 829-832 (in press).

thy. Furthermore, a way to increase one's own sense of efficacy is concretely try and experience the conduct as in the case of the "learning by doing" strategy in a positive context, by means of serious games. Social ro- bots are embodied autonomous intelligent agents that interact with people in everyday environments, imple- menting social behaviors typical of humans. In the context of educational technology, social robots have been shown to be effective in supporting knowledge and skills acquisition by engaging users during the learning process. Recent multidisciplinary experience positively assessed social robot to promote children attitude to- wards ecological sustainability[20].

A collaborative research/training with schools will be developed to experiment with the involvement of 50 primary school students the integration of robotics and serious game in teaching and evaluate the effective- ness of the game in terms of factors such as the interaction with the robot, the cognitive and emotional di- mension of children towards a healthy and sustainable diet and the propensity for physical activity. Students will be involved in a storytelling activity on the theme of healthy nutrition and the Food Pyramid created by the robot Pepper through pediatric and nutritional recommendations and subsequently in the creation of a weekly ideal nutrition plan with feedback from the robot. The teaching methodology will be that of the chal- lenge between students with prizes for the winning team. A digital app with chat bot and a virtual coach will be used for the engagement of the child with personalized advice and motivational support. A control sample of 50 children will carry out the same activity within a traditional approach with the teaching mediation of the teacher.

Specific objectives of the project are to:

- investigate teachers' needs and perceptions and promote innovative methodological approaches and assessment tools for teaching professionalism experimenting with game - based learning to promote children's problem - solving skills
- jointly validate the user experience and interaction of children with a social robot to promote obe- sity health literacy
- evaluate the cognitive and affective elements that make up the children's aptitude for a healthy and sustainable diet
- experience the robot as a tutor in a learning context and assess the impact of educational robotics
- promote the principles of the Mediterranean diet and enhance functional foods to encourage in- formed decision-making skills and healthy lifestyles of the families involved
- investigate the determinants of obesity and fight social prejudice / stigma in the direction of equi- ty and social justice
- early detection of body image disorders, eating disorders and of subjects at risk of non-alcoholic fatty liver disease
- ethical issues related to the introduction of robots.

Further step of the research will be validating tools and methodologies to assess the impact of introducing ro- botics into education, as despite the wide availability of tools and experiences, there is still a certain degree of uncertainty about and how to evaluate the outcomes of educational robotics. Other steps will be sharing the results with the subjects who have expressed interest in the project proposal. Dissemination and dissemination activities of the project will be carried out with the scholastic and scientific community. The implementation and assessment of the research projects will be developed in further contributions.

Conclusions

AI-based serious games are a new media in the context of e-learning, as the technological revolution has brought the need for the young generations to develop digital consciousness based on a creative and construc- tive commitment and the classrooms are proving to be learning environments evolving through technologies[21]. While AI in serious games is proving to help to massively personalize the gaming experience and create gam- ing scenarios, adjusted in real time, questions as "how can AI help make better games?" "Is it possible that AI improves serious game design and supports game-based learning and training?" must be further explored

[20] Cfr. Castellano et al., *Recycle*..., cit.

[21] Di Stasio M., *Making: Laboratory and Active Learning Perspectives*, in Scaradozzi D. et al. (eds), *Makers at School, Educational Robotics and Inno- vative Learning Environments*, Springer, Cham, pp.11-15, 2021.

combing different research areas in transdisciplinary perspectives on learning and collaborative partnership be- tween schools and universities.

It is increasingly necessary for the world of schools to collaborate with that of technological innovations. In a society increasingly projected towards technology, the educational institution cannot and must not remain firm on its own educational and training methods, on the contrary it must be able to involve all the interested parties in this process, and in this sense technology with all its proposals can play a fundamental role in facili- tating learning processes. It must be a tool for proper training of the pupil and therefore of the future citizen. From this point of view, serious games rediscover a fundamental role, as they allow the definitive abandon- ment of traditional teaching that no longer has any appeal towards young people, in favor of teaching whose focus is the pupil who is an active part of the teaching-learning process. Therefore, school and technological innovation must work together to ensure educational success and serious games represent an alternative form of learning, both as regards the method and the learning content, and can be used in various age groups, from primary school up to university, proposing the acquisition of both traditional and transversal skills.

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