Abstract

Active play seems to help build understanding across concrete reality and abstract things. It taps into the world of “fun”, affects emotions and have the ability to involve users more deeply. At the same time, it has the potential to motivate behaviours and rises the awareness on how real systems works. This process moves several questions about: the role of technologies in enhancing education, what is the change they can favour at societal level in using game-like applications in educational environments. The present paper discusses these empirical and pedagogical drivers contributing to the implementation of gamification design in the learning processes. Furthermore, it presents a practical case, the InLife’s approach, an Horizon 2020 project for designing different reality-based serious games scenarios. Through InLife educators, parents and therapists can stimulate pupils’ learning process by maximizing enjoyment, engagement and motivation. The InLife project is used to discuss the benefits and limitations of gamification design in two peculiar learning environments respectively addressed to pro-environmental awareness and social inclusion.

Keywords: gamification, IoT, serious games, gamified learning, educational environments, environmental education, social inclusion, behavioural change.

1 BACKGROUND

Scholars, educators, health professions and media designers are increasingly interested in whether and how digital games might contribute to personalized learning and rehabilitation.

Games can help to solve real-life problems that researchers, therapists and educators propose. Players can collaborate with neighbourhood in daily life tasks to save energy in Social Power [1], or can increase their awareness and knowledge about nutrition and healthy lifestyle of children in MyCyFAPP [2]. Through games people can generate skills and new knowledge to change the world and face real-world problems by learning, practicing problem solving in a safe environment [3].

Games and game-like elements are examples of modern educational theory [4] [5], however, especially in Europe, there is still some frictions for a comprehensive adoption of the new playing models in the environment used to learn. The main barriers to advance the introduction of serious games and gamification potentials is the current practices of formal schooling, the dearth of evidence on how to integrate learning contents and individual game play with instructional needs and lack of models to stretch beyond single classes the game projects. Understanding the role of gamification and serious games in education, therefore, means understanding the circumstances that drive the contemporary learning behaviours and the new teaching and learning framework needed to facilitate in a simple and intuitive way the translation between mediated learning environment and the daily life. The idea is each learner has different learning requirements, skills to train so we should deploy an educational framework that provide customized instruction. This has not an universal value, but it should be able to adapt the tool to the learning environment and address the real challenges of education. Indeed, while the concept is theoretically supported [6], we would like to point out that very few educational frameworks focus on reality-based game play applications. In fact, most of them were designed for the purpose to training players in specific ability by providing specific instruction. This is the case of games for sustainable mobility, energy saving or in general behavioural change [7]. Our aim in this discussion is precisely to advance in the direction of providing a platform which can incorporate many different educational-based game activities. This paper hypothesizes that the connected, immersive and interactive learning environment provided by game-like applications to its users may contribute to develop and enhance their skills in the real-world situations. Specifically InLife Platform advances two pilots: AKSION, a serious game for social inclusion and ICEBERG, a gamified virtual world for promoting pro-environmental behaviours.
2 GAMIFIED LEARNING

The gaming concept in education include four specifics categories: gamification, game-based learning, serious game and simulation [8]. For this reason, over the last few years, serious games and gamification are often grouped together. It's true that they both motivate learners and enhance their e-Learning experience. However, there are certain characteristics that set them apart.

Serious Games are experimental games specifically designed to achieve some change in the player [4]. The serious term stresses out a range areas outside of the context of entertainment. The change can be in knowledge, physical ability, reaction attitude, health and wellbeing, social skills. Serious games aspects include simulation, the pedagogical value of fun and sometimes competition [9]. The gamification approach is relatively new and is defined as a use of game mechanics, dynamics and frameworks to promote desired behaviors into domains like as health, politics, citizens engagements, marketing, academy and so on. Lee and Hammer identified three major areas in which gamification can serve as intervention: cognitive, emotional and social [6]. Both concepts find their power to engage and motivate players and are examples of modern educational theory that promotes personalized learning. These features can expand also the new learning models outside the traditional school environment in other life contexts. In practice people can play wherever the technology arrives to gamify the environment as well offering teachers new tool to guide and reward students in lifelong ways.

The convergence of games, learning, and technology provides personalized interventions that place the individual in the center of the action, especially with the new integration of Internet of Things paradigm that drives the reality toward game-play activity. This new direction is called Smart Serious Games (SSGs) and uses objects for tracking and interacting with locations, movements and also ecosystem experiences [10].

In games that include IoT there is an instant feedback loops between reality and game. Players repeat tasks and play out the assignments. Students are part of an improvement process, not immediate in traditional classes. The freedom to fail [11] [12] [13], that encourages players to be engaged in a safe environment, with IoT comes to change, inviting more awareness in the choices to act. There is a positive relationship with failure in the game-based realities, and a different way to progress and learn. In the micro-scale of such games for learning approach there are no failures but choice of assignments. Another emerging principle typical of is the social interaction (collaboration, competition, cooperation) that provides to mediated environment the idea of people-involvement around problems solving and knowledge creation. What really matters in social game system is in the network and the ways people are interconnected more than knowledge provided [14]. These aspects of the theory-based gamification and serious games can transform students’ perspective of learning and increase motivation giving actionable tasks. However, the applied game-theory experiments show that gamification and serious games can only provide tools and we must develop meaningful assessments of whether students are achieving their aims. This is the InLife project purpose.

3 PEDAGOGICAL DRIVERS

Several educational interventions aim to modify behaviours in order to promote better attitudes and to avoid fostering unhealthy behaviours for the self and other human beings. In the behaviour change wheel, Michie, van Stralen and West [15] conceptualize how behaviours can be affected by three main components: capability, motivation and opportunity. In this framework, the gamification process in education can be carefully designed to support all these components. For this reason, the incorporation of gamification approach in education is highly motivating for children and adolescent. The use of technology expands the opportunities to access at educational tools that supports people at different levels and increases their capability independently to psychological and physical individual aspects. What this leads is to the power of personalization of learning already utilized by game-based learning through technologies. Huang and Soman defines six common pain points in education: focus, motivation, skills, pride, personal factors and learning environment [5]. In gamification approach, researchers, designers, educators and therapists can also work on the six crucial points, especially on increasing the motivation to learn. Landers explains in his theory of gamified learning the two different processes that could be used to affect learning-related behaviours: a more direct mediating process and a less direct moderating process [16]. In the first one, gamification encourage the emergence of a behaviour/attitude that influence learning outcomes. In the second one, gamification reinforces the relationship between instructional design contents and outcomes without direct effect on learning. In both processes, gamification can influence behaviours but in practice some projects can fail.
Gamification is not an universal successful key. Several studies aim to understand how gamification process could influence positively the learners. In his literature review, Jackson shows that in general gamification is efficient in the educational field, especially to motivate student and to enhance learning [8]. In tandem with the creation of gamification projects we must develop meaningful exchanges among learning behaviour and adaptive system able to support different learning attitudes and environments.

4 THE INLIFE APPROACH

The matching between educational theories, game development and IoT is used to develop a model for the creation of complex learning environments. InLife’s core concept leverages on the potential of the Internet-of-Things (IoT) paradigm to create a link between specific course of action and the learning process. This unique feature allows games to operate within the reality.

InLife supports positive changes in players’ behaviours through a smart gamification platform. Providing a unified platform, InLife put the learning elements into a game-reality context in which actions and task can be practiced and skills acquired.

4.1 Methodology

To design an effective gamification model that address the real challenges of a modern education we focus on the target audience and the goal of each actors involved by using personas. This methodology consists in creating fictional characters in order to understand user needs, experiences and goals [17]. Identifying the target audience for an educational intervention using game-like application is critical to both designing the experience and the measure of its learning efficacy. Developers, contents' authors and end-users are the major actors of the platform.

4.2 The Pilot

These following pilots aim to evaluate the effectiveness of the InLife gamification platform toward two instances of games for learning in order to identify key aspects and provide some guidelines for best practices.

The goal with ICEBERG is to manage natural resources to make the game world growing and through it to enlarge the Yeti community. AKSION project provides the experience to copy with social inclusion skills and anxiety when offered the chance to travel over a spaceship.

4.2.1 ICEBERG for pro-environmental awareness

ICEBERG is a serious game that arises as a combination of a Role-Playing Game (RPG) and a strategy game, which is developed in an imaginary world of ice. The main creatures living the game environment are the Yetis, and there are non-playing animals, such as penguins, polar bears, orcas,
seals, etc. Each player interacts with his/her own Yeti to make the ICEBERG world growing. There are several types of resources to manage in ICEBERG, the most important are the ice blocks, which are produced by the penguins, along with other resources such as energy, vital for construction or food necessary for the maintenance of animals.

The game has a strong integration with the real world through the resource incentives system. When the players' behaviour in the real environment is respectful and they are trying to be efficient in energy saving (switch off the lights, save water, close the windows when the heating is on etc.), then the incentive system will reward the player with new characters that will allow to increase and improve the virtual world. For instance, penguins are able to produce blocks of ice, polar bears are able to build buildings, etc. On the other hand, if the player's behaviour is contrary to expectations, this will also be represented in the virtual world with virtual penalties (ICEBERG could start to melt, some penguins could be disappointed and leave).

The game world aspect starts with a central fixed design that would be the house of the Yeti character and would simulate the tip of the iceberg, and a variable design that simulates the rest and whose size can grow and decrease depending of user actions.

A minimum size of island is established and it cannot be lowered independently of whatever the user does. Starting from this size, the player will be able to grow its island in the form and size that wishes without limitation.

The characters that are on the island will walk automatically and randomly as long as they have a way to go, that is, the characters will not be able to cross buildings, so if they do not have a free way they can not pass from one zone to another. In case there is a locked character, the player can solve it by moving the position of a building to clear a way of passage. The main interaction modality of the game is linked to the action of players in the real world that in ICEBERG pilot case is a public and social space. This shift the focus of the rewarded action and aim to provide a valuable tool to raise the awareness on pro-environmental behaviours.

4.2.2 AKSION for social inclusion

The AKSION (Autistic Kids Social InclusiON) serious game is a mobile application designed for children with autism and other related special needs (Autism Spectrum Disorder, ASD), fostering social inclusion by supporting the development of social skills in virtual and real situations. AKSION allows educators to train autistic kids on adequate behaviours, according to the context, in an indirect and pleasant way. Autism can be considered as a different way to see the world and its rules. Autistic people has to cohabit with “two different communicative and social worlds”: the autistic one and the neuro-typical one. Everything is like they have to learn a new language in a foreign culture. Through the exploration of a variety of in-game environments like school, beach, gym, etc, children are asked to deal with everyday life situations in a funny and engaging way. In the world of AKSION, autistic children are motivated to improve their skills through game activities and a rewarding system designed according to their specific needs. On one side players command a spaceship and travel around planets, learning skills by a simulation of challenging situations; on the other side, they learn by
playing ‘mini-games’, aiming at training social and personal skills, on their own or with friends [18] [19] [20] [21] [22] [23] [24].

The AKSION serious game tells the story of an astronaut travelling along unknown and unexplored planets and tries to learn about the inhabitants’ traditions and behaviours in social context. To help the players throughout the scenario a system of advice and feedbacks is introduced. During the whole adventure, the player will be supported by a robot. This robot is the character’s first friend that gives advice to the player and guides him/her during the exploration of the planets. Its behaviour is friendly, funny and it represents like as a landmark for the player along the gameplay.

![Figure 3. AKSION game dialogue](image)

The AKSION game is composed of two main parts:

SCENARIOS: interactive simulations that lead the user through everyday life situations where they have to choose the more appropriate way to behave and proceed along the storyline. Every scenario is set on a planet that the character can reach with the spaceship. Some examples of settings could be a school, a park, a swimming pool, a mall etc. In every scenario, the player is asked to accomplish a mission while completing a predefined number of actions.

BREAK GAMES: minigames that allow the children to relax, have fun and test their abilities. Each game aims to train the player using the knowledge and the topics acquired during the scenarios sessions. Some break games could be configured using different set of categories, like stationery items, animals, facial expressions, urban sounds etc. Every mini-game could be used more than once with different topics, i.e. the memory game could display some cards showing animals, fruits, emotions etc. Some minigames are designed for single players while others can be specifically designed for two players or can be used for both formats. Considering the case of the two players’ mode, the tablet will be shared between the children and they will play the game taking turns simultaneously on the same device [25].

A key aspect of the AKSION is to teach children how to recognise and react to different kind of emotions, in order to better understand the different aspects of social inclusion [26] [27] [28]. For this reason, several situations regarding social inclusion in the most difficult context for autistic people, were designed and developed. Furthermore, some hints related to the recognition and expression of emotions through facial expressions were inserted in the game [29].

To influence behaviour in the AKSION game, a gamification system of rewards will be utilised to provide positive reinforcement when good choices and compliance are shown [30]. To unlock some customisable items the players need to use the spaceship currency that they get by completing the scenarios and the break games.

A system of medals and badges is integrated in the gameplay in order to motivate the player and reward their efforts. The achievements are structured into three main groups and reward specific skills and efforts related to them:

1. spaceship (astronaut skills, first landing, customisation...)
2. scenarios (scenarios completed, correct answers...)
3. socialisation and other skills (break games succeeded, b.g. completed, new friends...)
The UI design was conceived according to the theme of the game narrative: a cartoonish style combined with a sci-fi layout [31].

5 DISCUSSION
As gamified learning spreads throughout the real world there is a question of how practically realize it. Strengths of both gamification theory and pedagogical perspective can be complementary and significant for enhancing learning at school and outside the traditional learning environment. The two games foster behaviour change focusing on the users’ behaviours and adaptation. They utilize instant feedback, the ICEBERG connected with the reality through the IoT infrastructure and the AKSION more narrative through dialogues and social skills. The storytelling is peculiar of both game environments and can positively impact learning. Providing mediated worlds the two applications aims to contextualize real situation in a gamified world highlighting some behavioural dynamics that link the digital and the real.

Another aspect included in such experimentation is the collaboration, embedded in the environment in one case, explicit in the second one. Although the social features of a network are not embedded, the games run a social process that involves the player’s circle and group around. Educators and people living the same space become either non-player characters. Also the emotional aspect play an important role as key to harness motivational power of games and apply it to real problems such as environmental awareness and social inclusion. Those experiences create the need to couple the design of applications with the real challenge of the learning environment. Thus, the attempt to provide a platform that facilitate players to learn in real-life. By making the development of the gamification platform adaptive and expandable we can help learners and educators to personalize the education effectively.

6 CONCLUSIONS
These two case studies are useful in seeing how game-theory can be incorporated in a real scenario-based activities. There is a current trend to use game-based learning as a tool to engage and motivate students and to enhance the learning experience in the classroom. However, the introduction of gamified technologies advancements presents some challenges. Technical challenges involve the design of the feedback loops and rewards that have the direct links to the definition of assessments. Games can involve sensors for the gameplay based on the environment requirements and condition this imply also a particular attention to the scalability of the application. Thus the objective of the presented InLife project is to address this need in a tool easy to use by educators, teachers and developers. The potential application of InLife for behavioural change is presented as a practical way to incorporate the learning goals into a reality-based gameplay environment.

ACKNOWLEDGEMENTS
Authors of this paper, on behalf of InLife consortium, acknowledge the European Union and the Horizon 2020 Research and Innovation Framework Programme for funding the project (ref. 732184). Furthermore, we thank the Advisory Board and the evaluators and the project partners.

REFERENCES


