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Innovation as humanity's resource: How play can make the UN's 2030 goals achievable

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***Abstract*—** *With the ever-growing demand for solving problems common to all countries, world forums have seen a rise in its protagonism in the discussion of these issues. Since definition of the Sustainable Development Goals in 2015, discussions have increased on how the goals can be achieved to ultimately generate a more sustainable world. Each country should bring its, but so far, many goals are below expectations, worrying the UN - especially after the COVID-19 pandemic that shook the planet. Some of the adversities encountered in joining forces in the face of these challenges are the lack of unity between countries, distrust in supranational bodies, poor knowledge of how similar situations are treated and lack of creativity in generating ideas and solving these problems. From this, it is suggested that playful play can help to save humanity in setbacks since, through play, people can develop a sense of empathy, as well as an understanding of different material conditions, which leads to improving creativity and, as a result, innovative solutions. There are already some games both physical and digital that are in line with the SDG (Sustainable Development Goals). However, the digital games industry is increasingly growing among young people and adults alike, and they can maximize the power of gamification, which is to make playable a real situation. This research, with an exploratory theoretical character, concludes that playability - especially gamification - is on the rise and can help civilization to build a more humane and sustainable world.*

I. INTRODUCTION

In the past decades, discussions about globally commutual problems have intensified. Except for a few locally specific issues for each country, there are concerns – almost all derived from social inequality - that are common to every country, such as poverty, conscious use of resources, health, famine, climate change, *et al.*

In 1972, in Sweden, embryonic dialogs emerged through governments' spokespeople of several countries at the United Nations Conference on the Human Environment. The event aimed to understand the rights that families should have in a healthy and productive environment. There was also a series of meetings to discuss adequate food, housing, and clean water as human rights along with the need to reconnect humanity's touch with nature, which led the UN to create global institutions to closely monitor the subject [1].

In the period of the following 20 years, a consensus – culminated in 1987 - was achieved by the UN, which pointed out to the reaffirmation of the environment as not

being in a separate sphere from human actions, ambitions and needs. In this regard, it would be necessary to create a global agenda to change the human mentality, then, take actions to make development more sustainable. Subsequently, environmental agendas were discussed at the meetings of Rio 92 (1992), Rio +10 (2002), and Rio +20 (2012), in addition to the Kyoto protocol (1997) and the Paris Agreement (2016).

After the RIO+20 Conference, the document "The future we want" was published, aligning global monitoring goals with a focus on sustainable development. In view of this, a transparent process that encompassed the largest number of governments was launched with its aim set at universal development goals with a long-term vision, beyond the year 2015[1].

In detail, the Millennium Development Goals (MDGs) were created (figure 1). The MDGs described superficially, the focus points in the eradication of extreme poverty. The MDGs were incorporated by the UN members in the year 2000, which encouraged that these goals were put to action in favor of global social development.

Fig.1: Millennium Development Goals [2] (MDGs, 2000)

Furthermore, conversations and discussions in working groups in 2015 the "UN 2030 Agenda" was approved as a direct continuation of the project. A declaration described superficially a revised version of the previous MDGs, this time, made up of 17 Sustainable Development Goals (SDGs – Figure 2). Until 2030, the committee seeks to engage all countries in building a better future and meet all SDGs.

Fig.2: Sustainable Development Goals from UN's 2030 agenda.

According to the World Bank (2019)[3], the levels of poverty have been reduced by more than 50% since the 1990's. On the other hand, one in ten people still live on less than $1.92 a day. Out of the most affected by extreme poverty, children make up for most of the numbers, for instance, one in nine children are undernourished, the vast majority living in developing countries. [4].

As for hygiene, six out of ten people still do not have access to proper services, and three out of ten do not have safe drinking water [4]. To make matters worse, even though the proportion of people living in precarious housing dropped from 39% in 2000 to 30% in 2014, the absolute numbers increased from 792 to 880 million people[1].

The weather is another worrying factor, as global warming encounters itself at a rampant level. According to NASA (2019), 2016 was the warmest year recorded since 1880. In addition, the Amazon rainforest, the most preserved green area in the world, of which roughly 60% belongs within the legal territories of Brazil, is currently in a delicate state. In February 2018, the deforested area was 17% of the total. If these numbers reach 20%, many predict that the world's largest rainforest would face an unrecoverable point, in a tendency to become a savanna-like biome [5].

In 2014, the Pew Research Center surveyed nearly 40,000 people in 39 countries to find out what they considered the main global concerns were. The most pointed out were climate change, the global financial crisis, Islamic extremist groups, Iran and North Korea's nuclear program and the power and influence of the United States and China [6].

Additionally, the World Economic Forum, in 2017, listed that 31,000 millennials from more than 186 countries indicated that the world's biggest concerns are: climate change and nature destruction, large-scale conflicts and wars, income inequality and discrimination, poverty, religious conflicts, corruption or lack of transparency, water and food security, lack of education, security, and unemployment rates [7].

These mentioned facts indicate that for the SDGs to be met within the established deadline, more than a union between countries and their people is needed. Many problems are still far from being solved and have a high complexity degree. Thus, we can observe a lack in creativity and innovation to be resolved.

Aware of this challenge, Canada conceived in 2001 the World Day of Creativity, adopted by the UN and held on April 21 every year in more than 50 countries. The day

promotes the use of creativity and innovation so that the 17 SDGs can be achieved [8]. The need for creativity in social, environmental, and economic development is increasingly visible. Ali (2014) cites that nothing is as important historically as innovation, industrial and economic progress and, consequently, the well-being of humanity depends on it. Hence, where there is high technology such as manufacturing or pharmaceutical industries, innovation is most responsible for both increasing and sustaining quality and productivity, making it an essential factor in almost every aspect of human life.

For Schumpeter (1988)[9], innovation refers to any new policy that an entrepreneur undertakes to reduce the overall cost of production or increase the demand for his products. In consequence, it always represents a displace in the previously existing equilibrium state. When changes occur in the economy, the circular flow is disturbed, and the development process evolves.

In this case, changes can take five forms: the introduction of a new product; the introduction of a new production method; opening of a new market; the appropriation of a new source of raw materials; the achievement of a new industrial organization method of any kind. The combinations of these factors are essential for the beginning of the development process. The development process is to be carried out by development agents: innovators/entrepreneurs. The entrepreneur is considered responsible for creating the imbalance in Schumpeterian development [10].

However, these definitions do not cover all 17 SDGs, as some not are not directly linked to economic factor. Farfus [11] (2008, p. 36) mentions that current organizational models fail in terms of social demand - which form the backbone of the 2030 Agenda. This factor created by these social gaps allow for new initiatives to emerge. Thus, one of the strategies to overcome the challenges posed is the concept of social innovation.

Whether social or economic, innovation needs creativity which, in turn, can be developed through recreative activities. Playing is a pleasurable and recurrent creative activity in life as a child, generating and promoting the search for knowledge. It is fundamental to ideas and creativity, which are essential for innovation.

Consequently, the act of playing - in addition to being educational [12] can bring innovative ideas that are necessary to achieve the Sustainable Development Goals.

All things considered, the purpose of this work is to show how playing can lead to creativity and, consequently, to innovation, which are key in creating a more sustainable world for everyone. This research has an exploratory character and addresses concepts of play, creativity, digital games, and innovation.

II. WHAT IS PLAYING

According to Psychology studies based on a historical and social view of child development processes, from which Vygotsky [13](2007) is one of its main representatives, playing is a creative human activity, in which imagination, fantasy and reality interact in the production of new possibilities, interpretations, expressions, and actions by children, as well as new ways of building social relationships with other individuals, both children and adults.

The act of playing has a fundamental role in child development, as it is a natural behavior for children. Games have been around throughout all the formation of our individual lives, whether in schools, assisting learning, or at home in moments of leisure and relaxation. Such activity has fundamental role in the development of creativity, by providing a diversity of experiences [14].

According to Borba [22](2006, p.38):

> "It is important to emphasize that the proper way of communicating while playing does not refer to illogical thinking, but to an organized discourse with its own logic and characteristics, which allows children to transpose spaces and times and transit between the planes of imagination and reality, fancifully exploring its contradictions and possibilities. Thus, the planning of an informal play or game enables the construction and expansion of skills and knowledge in terms of cognition and social interactions, which certainly has consequences for the acquisition of knowledge in terms of formal learning".

Then, it becomes apparent that playing places the child in a social context, as it provides interaction with other children, with an environment created for a given situation, and with the toys available. When playing, the child will create a scenario, a context, select what will be part of it and apply the real knowledge they have already learned in the situations created during the game. According to Vygotsky [13] (2007), such recreation helps children to appropriate and mentalize the world in the social context in which they were born at, internalizing the concepts and materiality that occur in the external environment.

Salomão et.al. [15] mentions that playing is one of the main ways of learning - if not the only from which we

obtain concrete cognitive process. To learn, one must attain distance from itself, a situation that is practiced through playing. From the point a child is separated from the mother, this adjunction is generated, which stimulates the child to think and learn different things than they might already know. Such stimulus can generate a discernment that can even differ from what is proposed as learning in such activity.

In this context, the importance of the toy is highlighted. It serves as a tool of a playful function, since it is directly linked to the feelings of fun and pleasure of the child, in addition to having an educational function, as it teaches to complement the individual and the context around him [16]. A toy can be defined as an object or a playful activity, usually aimed at children's leisure.

According to [17], the types of toys can be separated into the following segments: affective development, early age, technical world, physical activities, intellectual activities, creativity, and social relationships. Any of these segments stimulate the mind and therefore the cognitive process.

On another hand, Kishimoto [18] defines a toy simply as the support object of play. Brougère and Wajskop [19] associate the toy with a cultural object, with its meanings influenced by the environment/ historical context in which they are inserted. An example is the Barbie doll, which represents the standard of female beauty in modern western society, but in other times it could have been synonymous with excessive thinness.

These plays, in turn, symbolize the function that a particular toy represents for the child. A broom, for example, can be used to symbolize a horse in a game. For Vygotsky [13] (2007), play is an imaginary situation created by the child, in which they manage to satisfy their impossible fantasies in the real world, thus born of a frustrated desire for reality.

The author also states that child's games provide great leaps in their development and learning. According to Leontiev [20], children can, through the act of playing, compare their abilities with those of others, as well as understand his social role.

2. Play and creativity

As argued by Lira and Rubio [21], it is in moments of free play that children express themselves and develop their creative process. These authors call these moments of total creative freedom "spontaneous play". In this sense, Vygotsky [13] states that "playing is a creative human activity." (p.18). This same author, on the concept of playing says that when a child play there is a relationship between memory and imagination and between reality and fantasy.

Vygotsky [20], presents a perspective or idea similar to the authors mentioned above, but goes a little further, saying that creativity is everything that human beings create anew. He argues that human beings can have two types of impulses that are at the base of a creative attitude. These impulses are called "reproductive" and "creator" or "combiner". The first impulse is related to memory and the fact that humans can reproduce something they have already seen or experienced, the second impulse concerns the creation of something new or the reformulation of something already done, based on previous experiences. This way, they can adapt better to the world around them. It is with this second impulse that the human being may go further, creating something new and innovative. This same author states that the imagination of the human being to create something new is related to his reality and experience. For this reason, Nascimento [22] (2004) says, "the richer the experience of man, the greater the material available to the imagination." (p. 15).

According to the psychoanalyst Winnicott [23] (1975), "It is in playing and only in playing that the individual child or adult is able to be creative and to use the whole personality, and it is only by being creative that the individual discovers his self." This quote demonstrates the essential relationship between creating and playing.

III. THE DIGITAL GAME INDUSTRY AND THE GAMIFICATION OF REAL SITUATIONS

The Digital Games Industry (DGI) became one of the study objects of this work, as it can provide technological innovation and a new way of playing.

Digital games can be defined as games built through digital technology [24]. According to [25], digital technology is a set of technologies that mainly allows the transformation of any language or data into binary numbers, that is, into zeros and ones (0 and 1). All the technology we know is translated into numbers, which are read by computers.

The Digital Games Industry has achieved significant growth in recent years. According to consultant PricewaterhouseCoopers [26] , the digital games market moved US$ 65.7 billion in 2013, and was expected to reach US$ 89 billion in 2018, projecting a growth rate of 6.3% per year in this period. It is worth noting that according to Forbes magazine [27], the global gaming industry moved US$ 175.8 billion in 2021. One of the reasons for the growing importance of digital games is that they are not only consumed by young men, as is

traditionally thought, but also by children, women, and the elderly [28]. This breaks the paradigm that games are only for children and for fun, as they can be seen used for other purposes.

Videogames are used in the education sector, training in companies or institutions, architecture, and civil construction, by companies or people who need to carry out a selection or coaching process in, for example, the health sector, gyms, and personal trainers, among others, practically covering all the sectors. In addition, it is noted that the use of technology is more attractive even when the function is really to play.

Consequently, they are attractive to all ages, regardless of gender, and can serve for multiple professional purposes, as pointed out. The main difference with respect to physical games is the need for a digital device so that it can be executed, which can be a video game console, portable console, computer or even cell phones. On another note, DGI can be classified according to its different platforms, which are: console (for television), mobile (for cell phones and tablets), PC (for computers) or even online (internet connection dependent games) [28].

Lately, evidence of recognition of the importance of the DGI have been expressed from the governments of several countries, such as Canada, the United States, France, England, South Korea, China, and Australia, from which all chose to adopt public policy mechanisms to stimulate its development.

According to Mello and Zendron [24] (2015), it is a very dynamic and innovative industry, whose compromises with high technical knowledge for the development of games, creativity on the part of the industry, uncertainty in investments and the patenting of hardware and software. Innovation is related to both the modernization of game platforms and the development of games that are increasingly attractive, and that are increasingly complex.

Parenthetically, another interesting feature of the videogame industry concerns its very interactive and concise communication language, since such language is based on the need for computer programming knowledge, which adds value to the product [24].

Technological advances have contributed to progressive changes at the DGI, including the expansion of hardware processing power, the increase in graphics capacity, the expansion of the internet and mobile broadband, in addition to the insertion of smartphones. Such changes provided the rise and popularization of online games, which aids in connecting people even more, generating growth in the industry as a whole. Figure 3, taken from PwC [26], shows the evolution of different digital game platforms in terms of revenue.

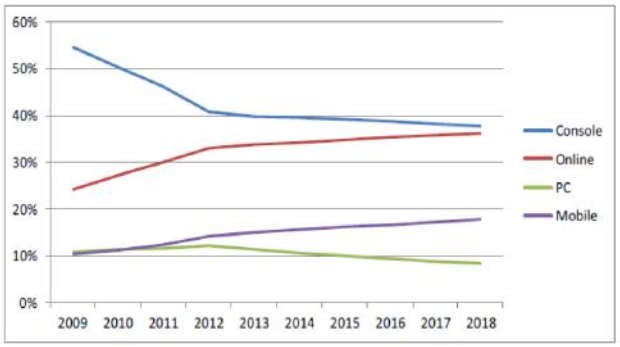

Fig. 3: Plataformas de jogos digitais em termos de receita mundial

As previously mentioned, digital language can be applied both for entertainment and for professional purposes, in the areas of training in companies, selection processes in the human resources and teaching sectors, in a more playful and "gamified" way. This ultimately attracts people from the newer generations and achieve better/ more efficient results for companies.

Finally, this same gamification format or trend can be used as a ludic way of solving problems directly related to sustainable development.

IV. GAMIFICATION OF UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

One of the 169 goals defined by the UN concerns the need for "students to have acquired, by 2030, the necessary knowledge to promote sustainable development".

In general, the student's interest in his role in sustainable development is not always latent [29], which implies that the educator has the role of fomenting their interest, offering new teaching and learning methods that can connect and make the student aware for his conscience as a responsible citizen and professional in the future [34]; [35].

As mentioned in the previous chapter, the implementation of gamification amidst the solutions for commonly pointed out problems, can increase young people's interest in solving them, hence, sustainable development is at aim.

According to Cheng and Su [30] (2012), students proposed to game-based learning models can obtain better results in knowledge acquisition, content understanding, perception, and cognition, as well as behavioral, affective, motivational, and physiological changes.

Gamification can be considered an educational approach, extracted from games, and transplanted to contexts whose purpose goes beyond entertainment.

According to Hammer and Lee [31] (2011), the gamified approach aims to transpose the design of games to other situations. It has already been widely diffused as in use by the military, education, and management areas.

Prensky [32] (2001) states that, in teaching, games are used as an alternative to reach a generation of "digital native" students from a globalized and more technological context than previous ones, who do not feel connected, emotionally, and cognitively, with the conventional teaching model.

According to Charsky [33] (2010), several games are a result of gamification itself and offer a rich and risk-free environment for the active exploration of topical, intellectual, and social problems, thus extending the use of the game as more than just entertainment.

The student, in the current global context, is the protagonist of sustainable development, in addition to being beneficiary [36]; [37]; [38] - a fact that that happens because they will be the ones living surrounded by this reality in their daily lives, just as in their future professional career.

Taking this fact into account, education training institutions must be critical in their teaching policies and practices so that disciplines that encourage diversity, interdisciplinarity and discussion on global agendas, such as the SDGs are included [36]; [34]; [35].

Yuan [29] (2013) mentions that the student has moments of alternation in feeling as a protagonist in this sustainable development, even though there is a greater discussion of these issues in the curricula [37]. Therefore, the role of educators is to raise awareness on the subject, using different and dynamic didactics, which can attract attention to the resumption of constant consciousness of a citizen, having the power to influence the future of everyone in the world, as well as understanding that their professional trajectory is directly affected [34]; [35].

By identifying that gamification may involve employees better than other more conventional ways, as well as learning in a more fun and productive way, organizations and companies are increasingly adhering to games to instruct and educate people.

Taspinar [39] state that, theoretical content is essentially extremely boring and promotes the brief disinterest of those who are consuming it. Games mitigate that effect, since they combine content with self-directed learning, as they are interactive and do not allow space for boredom to fill the player. Thus, it is an excellent option to meet the demand of the content, but with a focus on learning.

Still, Van Eck [40] cites that the effectiveness of games in learning is not only because they are fun, but also because they have the ability to immerse the player, in a way that requires frequent interaction and that makes them think about the decision that is being made, as well as adapting to needs, promoting inclusion and socialization.

Teaching sustainability through games, is viable, since there is an interdisciplinary approach, given that games can connect several different individuals and would act as complementary resources to those that already exist within conventional methodologies for education and training.

On the whole, Games, by elevating the aforementioned characteristics responsible for promoting useful experiences, are also an alternative education for sustainability, as long as it has student-centered approaches [41]. This point reinforces the indication that gamification can be put to work on the UN Sustainable Development Goals, fomenting situations to contextualize and generate ideas for achieving the goals of the 2030 Agenda.

V. STATE OF THE ART: GAMIFICATION

Some authors have studied gamification as a problem-solving tool. In this section, some of these works will be cited.

Gamification has the purpose of inserting, in a game, a certain real context. Taking this fact into account, Carse, - one of the most promising individuals on the subject - says that: "there are two kinds of games. One could be called finite and the other infinite. A finite game is played for the purpose of winning and an infinite game with that of continuing to play" [42].

Forgiarini and de Quadros [43], studied the state of the art of gamification, which identified an expansion in this technique and that the world is moving towards a job market with a more ludic format, aiming at increasing productivity and problem solving.

Araujo [44] studied the importance of playing games, and its relevance in the context of the COVID 19 pandemic for the development of early childhood education students. The author concluded that the use of physical and digital games were strong allies for the new methodologies that teachers have been adopting.

Kim and Lee [45] did dynamic modeling to assess the educational effectiveness of gamification for learning. The authors proposed a dynamic model of learning - based on games - that aims to maximize educational effectiveness,

featuring four main factors: curiosity, challenge, fantasy, and control.

As revealed, the study, based on the MDE framework (mechanics, dynamics, and aesthetics), created an equation for educational effectiveness. The result of the model showed that the efficacy of gamification of the learning process is educationally superior to traditional ways of learning in a specific environment.

Roy and Zaman [46] studied the efficaciousness of implementing game design elements in an online learning environment, addressing three main points: (1) analysis of the underlying motivational processes of gamification from a Self-Determination Theory perspective, thus explaining the motivational effects of various game design implementations; (2) subtle motivational changes empirically assessed over time, and (3) account for potential individual differences in the motivational effects of gamification.

The results illustrated the significance of the individual nature of motivational processes, the importance of sensitive motivation measures and the relevance of the design features of the implemented game elements.

Khuffash [47] developed a database of gamified systems. A total of 79 systems were studied, which focused on the following sectors: consumer, education, business, governmental, health, social good, research and finance.

The authors concluded that gamification is here to stay and will become an important tool for solving problems: whether they are business-oriented, personal, or social.

VI. CONCLUSION

When carrying out the research, it is noted that several authors have reviews about gamification and its positive impacts on learning and the contextualization of a situation for a person.

Already widespread in corporate environments and gaining more and more space in educational institutions, gamified approaches to sustainability present themselves as good alternatives for the advancement and dissemination of the UN Sustainable Development Goals.

It is also noteworthy that, according to the literature review, the method can be used to simulate a context that is not experienced by everyone and can generate similar ideas and open innovation to accelerate the ideal of a more sustainable world.

For future work, the following can be mentioned: performing an empirical analysis of a group that plays a game on the SDGs thematic; to analyze further how SDG gamification can generate innovation to solve similar problems in different countries.

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