

Understanding the Nature and Effects of Digital Games in Promoting Sustainability

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Abstract: - Based on an understanding of the goals and strategies that are most likely to produce successful sustainability transitions this paper aims to expand our understanding of how digital games can be used to advance such initiatives. The paper first reviews the benefits that games provide to their users and therefore explain their widespread adoption. Afterwards, the paper discusses more specific contributions that games can make to motivate active involvement, advance the understanding of sustainability issues and the elaboration of solutions, enable community support and political advocacy for the sustainability causes, and, finally, help citizens act in local, incremental, non-disruptive yet durable ways. Different types of games are proposed as more appropriate for providing each of these four contributions.

Key-Words: - sustainability; digital games; serious games; citizen scientists; political advocacy; pervasive games

JEL Classification: O39, O44, O49

1 Introduction

Stimulating widespread, relatively fast and long-lasting change in the living, working and consumption patterns of human populations is a crucial condition for addressing the causes and limiting the consequences of processes such as global warming and environmental degradation. This goal is at the core of many government programs, from the mandatory phaseout of automobiles with internal combustion engines (Burch & Gilchrist 2020) to programs seeking to educate and involve citizens, such as portions of the recent European Green Deal initiative. However, the success of such initiatives can be jeopardized by the skepticism, lack of support and even resistance of target populations, particularly if they perceive these initiatives as emanating from elitist, bureaucratic or even antidemocratic circles and as directly affecting their economic interests (Claeys, Tagliapietra & Zachmann 2019; Ponthieu 2020). Therefore, a key policy making and governance issue is finding ways to harness the energy, intelligence and skills of populations in order to transform them into allies for this quest. In particular, we need to understand how to involve the broadest possible range of citizens in defining changes through grassroots efforts and in implementing these changes in ways that limit the negative, disruptive impacts on peoples' lives (Patterson et al. 2017).

This paper aims to contribute to our understanding of these issues by investigating how digital games can be used most effectively to promote a transition towards sustainability in pluralist, emergent and non-disruptive ways. Games combine two characteristics that make them suitable for rapidly involving citizens in this kind of transition. First, because of their entertaining and challenging nature, they are more likely to attract a broader audience and provide a path of least resistance towards attaining educational and behavior change goals (Fabricatore & López 2012). In particular, they can prevent initiatives from being perceived as boring, government-mandated instruction or chore programs. Second, many games include some form of social interaction and therefore they can be used to develop the skills needed to convince or outplay other people or groups, as well as to coordinate actions and organize in order to legitimate and obtain resources for grassroots initiatives (Hromek & Roffey 2009). From a systemic perspective, these characteristics also transform games

into exploration tools that can be part of an ongoing process of identifying the most effective bottom-up approaches for educating citizens, as well as for stimulating and diffusing changes.

In this paper, we rely on a review of the literatures on games and their use for sustainability-related goals (Stanitsas et al. 2019), and, respectively, on the social strategies used to foster sustainability-oriented change (Levin et al. 2012) in order to build a theoretical framework that could inform the selection and development of games to be used for accelerating the transition towards a sustainable society. Results suggest that such games would combine features from four kinds of games currently used for entertainment and educational purposes. These results could contribute to the literature on games as innovative means for achieving an environmentally sustainable future, which tends to overestimate the educational and behavior-changing impact of games, by offering a larger set of goals and a more nuanced basis for assessing these benefits. Moreover, these results could provide interesting insights to the literatures on fostering and governing sustainability-oriented societal change, by suggesting how games could provide better means for emergent and non-disruptive transitions.

2 How Can Games Help?

Games have a long history of being used not only for entertainment but also for instrumental purposes such as education, behavior change and even psychotherapy (Blackmon 1994; Papadakis et al. 2020; Rosselet & Stauffer 2013; Wilkinson 2016). A recent trend is using games to increase awareness regarding environmental issues, explain the complex impact of human activities on nature, foster the active involvement of citizens with these issues, and facilitate the development and implementation of sustainable alternatives (for a recent review see Stanitsas, Kirypoulos & Vareilles 2019). A variety of material and digital game types have been proposed as candidates for achieving these goals but they are still far from achieving any sizable impact in terms of changing awareness and behavior towards sustainability

2.1 Exerting a widespread and lasting influence

Despite these efforts, sustainability oriented games are still a long way from attaining diffusion levels comparable with those of commercial entertainment games. To understand the road ahead, it is estimated that Pokémon Go has been downloaded over 1 billion times (Webster 2019). This suggests that an important aspect is grasping how sustainability-oriented games could touch a comparable number of citizens. In addition, even if Pokémon Go affected the behavior of many individuals and groups of friends who adopted the game, the impact has been relatively short-lived. Therefore, the first issue can be reformulated as understanding how games can exert a lasting influence on a large number of citizens not only in terms of awareness and learning but also in terms of permanent behavior change.

2.2 Enabling grassroots, non-disruptive change

As explained in the introduction, the needed social change is perhaps easier and more effectively realized if it comes in the form of grassroots initiatives, defined and promoted by citizen groups and implemented with minimal disruption for citizens' economic wellbeing and ways of life. From this perspective, the issue becomes understanding how games can be used to encourage users to take matters in their own hands, to create citizen networks and movements engaged in monitoring the situation, developing solutions, modeling their impact and putting together all the resources needed for their implementation.

In order to provide an answer to these issues, in section 3, we review the literature on game adoption and impact on individuals. Then, in section 4, propose a framework for assessing the kind of games that provide the entire range of benefits needed for sustainability oriented changes.

3 Understanding game adoption and benefits

Games and play are customary forms of human life since immemorial times. But what interests us in particular are the reasons explaining the extraordinary and continuing diffusion of what we call digital games, from videogame consoles, to computer-based games and to games on mobile devices, as opposed to more traditional table and outdoor games as well as sports. It is estimated that, in 2020, the worldwide videogame market size reached over \$159 billion and involved over 2.7 billion players (Wijman 2020). This includes 2.6 billion mobile

gamers, of which only 38% pay for their games (Wijman 2020). The literature on digital games, has identified a number of reasons for such widespread adoption particularly in the form of individual benefits, but also discusses the broader social impact of this phenomenon.

3.1 Individual perspective on game benefits

This subsection discusses the reasons why so many individuals play digital games, and many of them persist in playing to the point of becoming addicted, not only to gaming in general but to a particular game. The common explanatory argument for adoption is that, implicitly or explicitly, individuals perceive games as providing some benefits. According to a typical categorization of user-perceived benefits in marketing, these reasons can be divided into three categories that will be discussed, in turn, in the following sub-subsections.

3.1.1 Intangible emotional benefits

Digital games provide an alternative to the everyday boring experience of young and, increasingly, less young populations, both female and male. For example, action and adventure games provide challenges and cause emotions such as fun and satisfaction for achievement that are less and less available to typical, increasingly sensitive, security conscious and physically unfit urban and suburban dwellers. Through their forms of play, videogames extend the continuous entertainment provided by earlier means such as cinema and television by adding an illusion of agency and control, though seemingly consequential decisions, actions and exchanges. Moreover, videogames, particularly those relying on virtual reality, provide a “simulated lived experience” (Wolf 2015), such as an immersive yet ultimately safe escape in a different world, for instance magical, exotic, aesthetical or dangerous, and so, they become a plausible source of emotions from pleasure to fear (Lin 2017). Furthermore, game experience provides an environment that, unlike reality, gives individuals the impression that their potential is maximized, a source of satisfaction, which may take extreme forms such as exhilarating joy (Bartolucci, Mattioli & Batini 2019; McGonigal 2011).

3.1.2 Intangible and tangible social benefits

Like for any product, a large proportion of players adopt a game as a result of imitation or influence from peers (Bass 1969; Rogers 1962). Playing games or a specific type of game also allows players to express their association to a certain group or subculture, as well as to distance themselves from others (De Grove, Courtois & Van Looy 2015). But, digital games, especially multiplayer or team-based via Internet, also create occasions for interaction with other players, opening a space for social achievement and peer recognition (Verheijen et al. 2019). This may translate into more lasting socialization, as players create rather stable networks of friendships based on game-enabled acquaintances, through which they support each other through difficult times such as Covid-19 related confinement (Eklund & Roman 2017). Proficient gamers, moderators and scenario developers in open games such as Dungeons and Dragons can accede to central or broker positions that enable them to influence an extensive player network. For some of them, this may provide a path towards tangible, monetary rewards as participants in official competitions, as game testers or even as game developers. In sum, games create a virtual socialization environment that helps socially awkward individuals signal their affinities, learn social skills, join groups, and eventually transform virtual ties into real-world resources.

3.1.3 Tangible cognitive benefits

The way television provides complementary learning that can be useful in various personal, social and even professional contexts, players may also perceive digital games as a source of useful learning and skills. For example, war games teach in a captivating way the history of world conflicts and acquaint players with various forms of weapons and military action. Adventure games help players learn about various countries, habitats and explorations. Such knowledge could be useful for various professions, from military and law enforcement to tourism (Stott 2010). Gamers who otherwise would not set foot in a concert hall even become acquainted with classical music pieces used as a sound background in certain videogames (Gibbons 2018). Users may see this increased level of culture as helpful for accession to a higher social and economic status. Players may even value implicitly the sensation that games help them develop attention, spatial thinking and perception (Bediou et al. 2018), and in some cases, such as Wii, also sensorimotor skills. Of course, games designed specifically for teaching ‘serious’ subjects provide educational benefits, in particular by increasing interest and motivation, and by facilitating the understanding of complex subjects. But the context surrounding their use in schools and university programs, or as part of government-mandated programs, may not encourage such perceptions and the

spontaneous, wholehearted adoption from users, as it may do for teachers and instructors (Lavigne 2016). This moves us from discussing user-perceived benefits to the broader benefits of games as perceived by societies.

3.2 Societal perspectives on game impacts

Understanding the perception of digital games by a broader range of stakeholders is important because, in case this perception is negative, even if users would like to adopt game-based approaches, their use for advancing change for sustainability may trigger resistance from doctors, educators, parents, law enforcement officers and others who may fear that serious unintended consequences will outweigh benefits. Auspiciously, the discourse surrounding the social impact of games has shifted from seeing them almost exclusively as a source of psychological and social ills towards considering them as a potentially spectacular solution for all individual and societal problems. For example, games have long been deemed to cause sedentarism, addiction, depression, isolation, violence and crime (especially action games that involve fighting, stealing and shooting), and other antisocial behaviors and beliefs (Bonnaire & Baptista 2019; Nogueira et al. 2019; Sherry 2001).

But, after years of vilification, psychological research has also started to assess and explain the benefits of games for perception, attention, cognition, motivation, emotional balance, social adaptation, and even psychomotor skills, such as those needed to perform laparoscopic surgery (Granic, Lobel & Engels 2014; Bediou et al. 2018; Chalhoub et al. 2016). Educators also point out that digital devices instill a different kind of cognition style and skills, and that games may be among the preferred means of prepare such ‘digital natives’ for the emerging patterns of work in an increasingly digital society (Prensky 2001). Specifically for sustainability change, games may help users learn the skills needed for distance working and may shift their preferences from physical to virtual consumption, thus reducing the impact of their activities and leisure on the environment (Sims Bainbridge 2010). The term ‘gamification’ has also been proposed for the idea of including game elements in various activities as well as in the software and information systems that support them, in order to make task performance easier, more effective and more fun (Deterding et al. 2011).

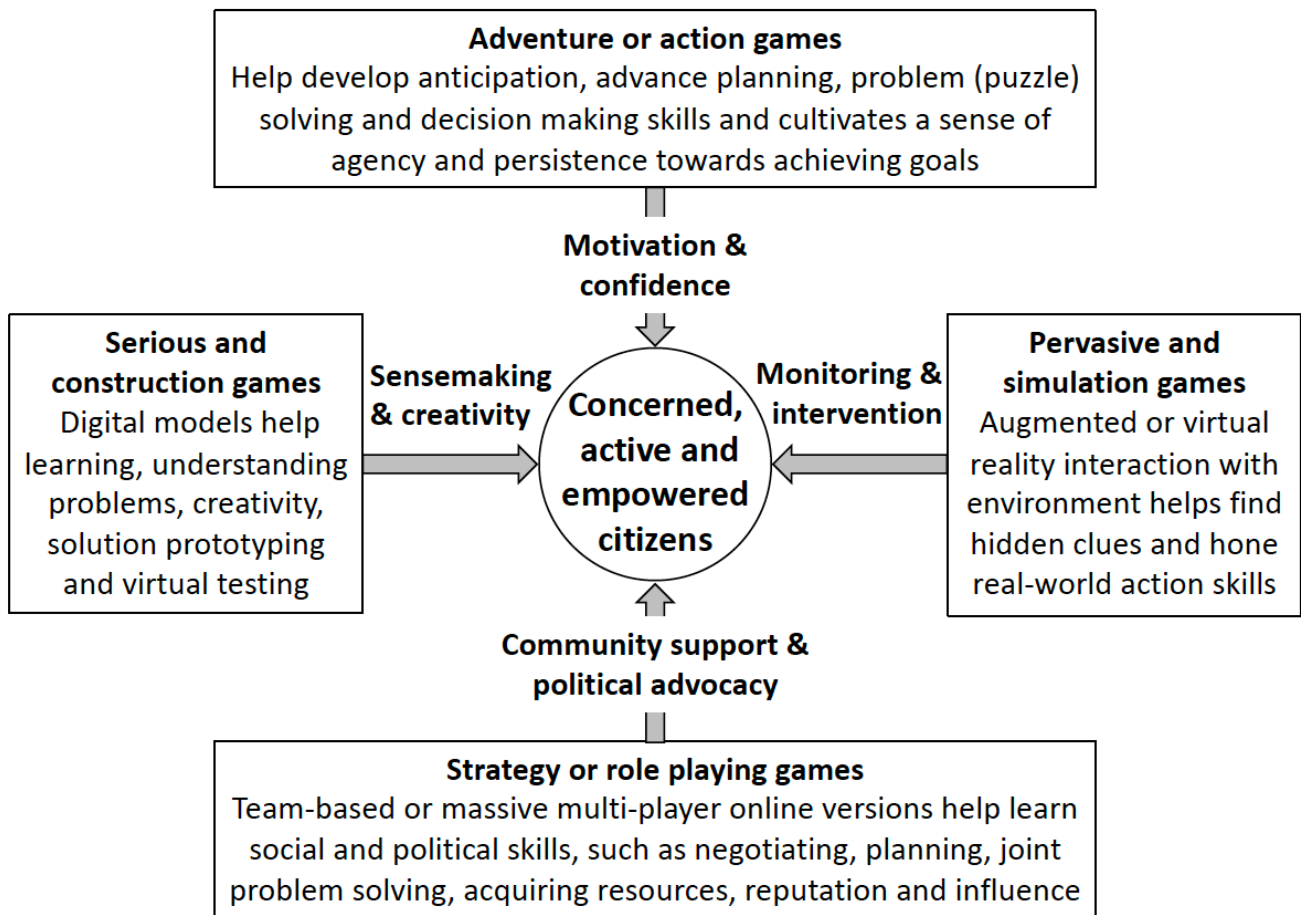
Although the debate regarding their social usefulness continues, we can safely conclude that games have their place in the arsenal of means which can be mobilized for sustainability-oriented change. To advance our understanding of the characteristics that enable games to become effective instruments in the transition to sustainability, the next section reviews the literature on different categories of games and their specific benefits, and relates these benefits to those needed to motivate and enable citizen participation in the transition towards sustainability.

4 Games as motivators and enablers of sustainability-oriented citizen action

To understand the impact of games in changing sustainability beliefs, perceptions and behaviours, we combine inspiration from a model about the impact of technological means such as games on sustainability, namely Melville’ (2010) belief-action-outcome framework, with a loose interpretation of Goyal and Howlett’s (2020) argument that four distinct collective actors are engaged learning that enables a transition towards sustainability. Goyal and Howlett (2020) call them respectively “technology constituencies,” in charge of developing of new tools and motivating their adoption, “epistemic communities” which provide and legitimate the needed beliefs, “instrument constituencies”, which develop and implement the corresponding practices, and “advocacy coalitions,” which secure the adoption of policies in support of the intended change.

These elements largely correspond to the results reported in the policy and governance literatures regarding the conditions for grassroots, non-disruptive and lasting change towards sustainability, the most common of which are motivation, knowledge, agency, and political power (Patterson et al. 2017). By combining insights from these frameworks, we argue that digital games involved in sustainability transitions are more likely to succeed if they afford their users the opportunity to acquire four kinds of capabilities, respectively, (i) motivation and confidence; (ii) sensemaking and creativity; (iii) community support and political advocacy, and (iv) monitoring and intervention. Below we review, in turn, these benefits, and tentatively associate specific kinds of games to each of them, as summarized in Fig. 1.

Figure 1: Specific benefits needed for sustainability transitions and types of games most likely to provide them



Source: Author-prepared by relying on the on reviewed literature.

4.1 Motivation and confidence through adventure or action games

Sustainability promoting games are more likely to achieve a level of diffusion comparable to that of commercial games developed primarily for entertainment purposes, if they provide players the most salient individual emotional and cognitive benefits discussed in the previous section. Two types of games appear more likely to provide this kind of benefits, by generating interesting and lively experiences, namely adventure games and action games. In adventure games, players advance in a graphic simulated environment or in a branching story by making decisions, solving puzzles or interacting with the environment or with other real or virtual players. Such games are particularly useful in attracting and motivating players regarding environmental issues, among others by allowing them to virtually become involved in real-life expeditions that trace the consequences of global warming (Henrickson & Doering 2013). In the process, players also have an opportunity to acquire knowledge about the areas in which the adventure takes place. Moreover, both adventure and action games with expressive graphics, virtual and enhanced reality, or games inspired by horror themes, such as *Plants versus Zombies*, can make less perceptible changes such as those stemming from global warming more salient as well as help fix the learning at a more fundamental, emotional and instinctual level, more easily amenable to manipulation (Lin 2017; Drezner 2014; Nasiruddin et al. 2013). For example, the same moral principles as those featured in game such as “*This War of Mine*” (Toma 2015), a survival game based on the problems faced by civilians during wars, could be extended to a game that would make more vivid the catastrophic consequences of climate change such as hurricanes and inundations. Some games also provide cognitive benefits by enabling players to hone their anticipation and planning capabilities for developing a course of action. This shapes their agency in particular ways, and may increase their level of confidence in their ability to effect change in the real world (Nguyen 2019). In the conclusion of this motivational subsection, it should be noted that the attraction impact of extremely

popular games is not only direct, through the number of players that adopt it, but also through their cultural impact, for example through the number of ‘memes’ that they generate and that are circulated through social media and influencers. This reach is much more extensive and may provide a subtler way of involving citizens in sustainability transition. So, the potential ‘memeability’ (Mercer & Sarson 2020) of a game could be, along with play challenge and thrill, another source of impact.

4.2 Sensemaking and creativity through serious games

Students of social and ecological systems and of the interactions between them, particularly of the attempts to foster sustainability through social change, frequently underscore the complexity of the concerned systems and processes, and the difficult, super wicked nature of the problems faced by those who devise interventions and transitions (Kirwan, Maye & Brunori 2017; Levin et al. 2012; Wiek et al. 2012). A key enabler of success, particularly in light of alternative discourses, is understanding and assimilating the established knowledge, for example the latest scientific data and models (Barth & Michelsen 2013). However, citizens involved in solving such wicked problems also need capabilities for sensemaking about the complex interconnectedness between the concerned systems, and for further gradual, concrete, action-based learning in interaction with the systems (Lehtonen et al. 2018; Van Poeck, Östman & Block 2020). Moreover, to devise non-disruptive interventions and transitions they also need to develop problem-solving, creativity and innovation capabilities (Mitchell & Walinga 2017). We believe that the category of serious games comes closest to enabling these capabilities. These are games relying on a ludic component to help education, learning, problem solving, skill development, behavior change and other non-entertainment goals (Schuller et al. 2013; Uskov & Sekar 2014). Serious games is a very inclusive term, which covers many of the other categories of digital games reviewed here, as well as table games (Djaouti, Alvarez & Jessel 2011). Many of them aim to explain scientific notions to students in a fun way, which makes them suitable as means of citizen education for sustainability (Clark et al. 2009). Serious games, such as Nufjord (Weines & Borit 2019), are increasingly used as teaching aids in schools to help students understand the complexity of environmental processes and of sustainability action (Chappin, Bijvoet, & Oei, 2017). The outcome of such games could be a stronger belief in the reality of global warming and other sustainability issues as well as in the effectiveness of proposed solutions (Wade & Piccinini 2020; dos Santos, Strada, & Bottino 2018). However, we believe that the main role of games is supporting the collective production and validation of understanding and of models for specific issues, perhaps local ones of concern to citizens and communities, along with the development of innovative solutions. In other words, pedagogy benefits take a back seat to sensemaking and creativity enhancement through platforms similar to Lego Serious Play, which enable systemic, visual or physical modeling of phenomena and solutions (Schulz et al. 2015; James 2013). Through collaboration capabilities, such game platforms could contribute to the creation of epistemic or inquiry communities (Soyturk, Gandolfi & Ferdig, 2020). Also, by complementing more mundane means such as paper sketches and physical objects, digital games could provide, especially through 3D imaging and virtual reality capabilities, a platform for problem visualization and preliminary solution testing (Marone 2016; Metze 2020). For a simulation of broader consequences of interventions, including their social aspects, platforms featuring construction and management game elements, such as world-construction games could also be useful (Rollings & Adams 2003). Together these types of serious games enable multidisciplinary collaboration by creating epistemic objects allowing the integration of various perspectives and contributions, as well as the rapid prototyping and testing of preliminary solutions in order to identify their shortcomings (Ewenstein & Whyte 2009; Jensen, Seager & Cook-Davis 2018).

4.3 Community support and political advocacy through strategy and role-playing games

Sustainability change cannot be implemented on the needed depth and scale if intended actions do not have the required legitimacy with those affected by them as well as the required resources needed for their implementation. Games could provide a platform that could be used to foster the needed local networks and communities as well as broader political advocacy movements that could influence political decision making at a national or supranational level. In strategy games, players acquire the skills and the confidence needed to confront opponents and compete for resources as well as to plan actions and manage the scarce resources available for their implementation (Fabricatore & López 2012). In team-based or multi-player games, players also get a chance to interact socially and perhaps define a common identity, along the lines of being involved in sustainability change. Another kind of physical and digital games likely to be appropriate in this respect are role-playing games such as Dungeons and Dragons and its numerous digital variants. This kind of games have been shown to be effective in fostering communities and collective identities that are necessary for effective collective actions (Bowman 2010).

Using massive multi-player online role games (MMORG) to foster the abilities for negotiating and obtaining resources for real sustainability-related issues is already being attempted (Chabay 2020).

4.4 Monitoring and intervention through pervasive and simulation games

The cycle of involving citizens on a sustainability path ends with the need to provide change solutions and initiatives with a distributed acting arm. The goal of ensuring an active local presence, for example in affected communities and near sensitive habitats and sources of greenhouse gases and pollutants, requires the capability to stimulate behaviors that are contrary to what digital games are typically deemed to encourage, namely a rather passive, stay-at-home stance. Games have to encourage behaviors such as becoming active citizen-scientists, who contribute observations, data and local insights, or agents of change who help communities and organizations understand the consequences of their activities and convince them to implement new, beneficial practices. A loose source of inspiration for such platforms could be active discovery games, such as Pokémon GO, which have managed to counter an often mentioned negative consequence of digital games, namely sedentarism (Nigg, Mateo & An 2017). Taking the form of a mobile augmented reality game, such platforms would stimulate participants to individually detect environmental changes and identify hidden clues for their emergence. A broader term for this game are pervasive games, which bring digital entertainment back to the real world (Magekruth 2005), by extending game play beyond its typical in “spatial, temporal and social limits” (Arjoranta, Kari & Salo 2020: 3). The addition of virtual or augmented reality capabilities would also enable to demonstrate the effects of sustainability oriented practices compared to existing practices. Eventually, such games would help achieve a more permanent involvement of individuals and groups in observing and immersing in nature, comparing observations, implementing and testing the effects of interventions (Rauschnabel, Rossmann & tom Dieck 2017; Ruiz-Ariza et al. 2018). An additional types of games that could support the active involvement of citizens are simulation games, which could teach players, for example, how to safely remove dangerous substances, rescues animals and perform other delicate operations. As mentioned above, games are already used for a teaching such skills even for surgeons. Virtual reality and haptic technologies could be combined into the platform to boost the teaching of such skills.

5 Conclusion

This review suggests that digital games have a significant potential in promoting sustainability transitions, and part of this potential is already being realized by a large number of initiatives. However, the different benefits that games can and need to provide, the many forms that they can take, and the costs involved in developing and promoting them raise a number of dilemmas that further research and the sustainability movement would have to address:

- Focus all energies on the development of one super-popular game, or let a large number of games emerge from different creators and enable their simultaneous use by different communities.
- Focus on games that are accessible to a broader range of publics including those with less advanced educational background, for example action games, or on games that require more advanced skills and intellectual interests, such as role-playing games.
- Create a simple game, which could be played even on the least advanced hardware platforms, or create expensive game that harness the whole range of available technologies such as virtual reality, and feature advanced graphics and naturalistic character movement.
- Create proprietary games, which would be developed and promoted by their owners, or open games to co-development, thus ensuring their continuous evolution and growth.
- Achieve all four benefits through one game platform, perhaps in the form of separate modules in a unified environment in which players navigate seamlessly to ensure their progression towards more advanced forms of involvement, or let benefits be provided by different platforms by a diversity of environments, to ensure that players will not get bored by uniformity.

Acknowledgement: The writing of this paper has been financially supported within the project entitled: "Support Center for IEM research - innovation projects competitive in Horizon 2020", ID 107540. This project is co-financed by the European Regional Development Fund through the Competitiveness Operational Programme 2014 - 2020.

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