Video game dynamics in unplugged mode for innovative and inclusive teaching[1]

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Abstract

The authors of this essay analyze the educational opportunities offered by video games by experimenting with an unplugged design, carried out within the framework of a Laboratory of Educational Technologies at the Degree Course in Primary Education Sciences at the University of Roma Tre. The aim was to enable students, future teachers, to build, in teams, a video game environment that could be reproduced even in the absence of the digital devices on which it is usually implemented and through which it can be reproduced. This last circumstance can occur in many school complexes, unfortunately still lacking adequate structures and instruments. The educational and pedagogical mission of the Laboratory was also to allow future teachers to experiment in a protected environment, the university one, the video game principles applicable even in disadvantaged class contexts. The educational objective was to ensure that the students involved in the design of the game master the philosophy of gamification, so that they could take advantage of it wisely and consciously in their future classes.

Keywords: video game, unplugged, gamification, didactics, inclusive.

[1] The essay is a joint work of the authors. However, for the purposes of recognising the individual parts, it should be noted that paragraph 1 is by Martina Marsano, paragraph 2 by Fabio bocci, paragraph 3 by Martina De Castro, paragraph 4 by Umberto Zona. The video game used to illustrate the laboratory activities is the work of Giovanna Giannetti, Roberta Giannetti, Federico Giunta, Laura Falcone, Martina Piffer.

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Video games and learning

Despite video games are being increasingly studied since, according to a large number of authors, their characteristics are suitable to promote forms of experiental and participative learning (Gee, 2013; Salen, 2008; Prensky, 2001), the public debate concerning their beneficial effects is still intense. On the one hand, video games are still being harshly criticized for the potential negative effects that they can generate in younger people, in particular on a psychological level (Engelhardt *et al.*, 2015; Rothmund *et al.*, 2015); on the other hand, numerous studies show the effectiveness of video games also in the educational and didactic field (Novak & Tassell, 2015; Cardoso-Leite & Bavelier, 2014). In this regard, it should be emphasised how the experiences related to their use in schools around the world have been multiplied. For example, one need only think of *Minecraft*, a sandbox video game[6], which thanks to its characteristics is being used at school to teach subjects such as science (Pusey & Pusey, 2015), mathematics (Bos *et al.*, 2014) and geography (List *et al.*, 2014), so much so that it became part of the compulsory curriculum in the Viktor Rydberg School in Stockholm.

Indeed, over the past few years, school has approached new technologies with the aim of responding to the needs of today's children and young people, which were born and raised in a highly digital environment and used to being constantly hyperstimulated by the many electronic devices that have entered into their daily life. These individuals, which have been defined by Prensky (2001) as *digital natives*, often struggle to follow the typical taught classes – that represent the core of the school activity – precisely because they are used to interface with highly immersive and engaging environments, unlike the school context that, instead, is inevitably perceived as static and unstimulating.

The most recent statistics certify the high interest of children for video games: one need only think that if children aged 3 to 4 years play 5,9 hours per week, for those aged 5 to 7 years we get to 7,3 hours per week, to go up to 10 hours of play for children aged 8 to 11 years (Statista, 2017). In recent years, then, the increasing popularity of mobile devices has led to a considerable increase in the development of applications (commonly known as *App*), often used even by young children. These data allow us to understand the importance of the digital dimension in the daily life of the very young people and how much it can affect the way they learn. In order to meet the needs of the new generations, in 2009 the Quest to Learn was established: it is a public school

[6] Sandbox video games are characterized by a non-linear structure and plot. In these games few limitations are imposed to the player, who decides the actions and the activities that he wants to carry on, having the possibility to roam in the virtual world and change it at will.

in New York that decided to use a game-based approach (Salen, 2008); in this school students learn through play and video games, working together in groups, while the teachers guide them in the learning process, becoming facilitators of learning.

Play allows man to learn from the very first years of life, so much so that the child begins to know himself, others and the world around him through the playful activity (Bruner *et al.*, 1981; Piaget, 1972; Vygotsky, 1972).

The video game, a tool that combines the playful element with the technological one, has a series of features that make it particularly suitable for the promotion of learning, so much so that even video games that are not explicitly designed for educational purposes can foster the acquisition of knowledge and skills, often without the player noticing.

The American linguist Gee (2013) defines the video game as a *semiotic field* in which it is possible to trace *internal grammars* and *external grammars*: *internal grammars* refer to the rules of the game; *external grammars*, instead, concern the social relationships that arise between the players outside the game, namely forums, blogs or websites dedicated to the game. According to the author, in the video game the identity of the player develops along three dimensions: the *real-world identity*, the identity of the player; the *virtual identity*, the avatar played by the player; the *projective identity*, the aspirations that the player has about his character's actions.

Gee also identifies 36 principles of learning that can be traced in *mainstream* video games. First of all, the video game differs from the traditional play for its immersive nature, which allows the player to take action in first person within the virtual environment, that is characterized by its complexity and by the presence of a large number of stimuli. In this environment the player is able to face situations that allow him to develop problem solving and decision-making skills, as he has the opportunity to immediately observe the consequences that derive from his choices. Furthermore, through the video game the player has the opportunity to learn the *situated meaning* (Gee, 2013) of notions and concepts that are closely related to the context in which he finds himself acting: that means that the player manages to internalize and understand them in depth precisely because he can experience them first-hand, in contrast to what happens at school, where the student usually has to deal with abstract concepts.

The player is immersed in an environment governed by a system of rules that he must necessarily follow in order to proceed in the game. The rules represent the essence of the game as they delimit the action of the player, allow him to understand the actions he can take and guide him in the game experience. In contrast to what happens with traditional games, for example board games, the rules of video game are learnt from the experience, that is by

discovery: that means that the player does not need to consult a handbook to learn them. Moreover, very often video games offer a short tutorial experience, during which the player gets a first approach to the game and its dynamics.

Structure, objectives, levels of video games

In video games, the player's actions are oriented to the achievement of specific objectives, which are always clear and explicit, so that he always knows exactly what to do. Every game has a global objective, the ultimate goal of the game, and many intermediate objectives, more commonly defined levels, through which the player is guided in the game experience and plans his future actions. When the player faces difficulties, the game provides a whole set of advices and indications *just in time* – exactly when the player needs it the most – that allow him to proceed further. The feedback system, moreover, allows the player to always be informed about his path, also representing a positive reinforcement. A typical positive reinforcement is represented by the reward system, which allows the player to receive a reward when he accomplish the objectives: some examples of rewards are level progressions, points, virtual money, bonus and upgrades.

In video games, the goals' achievement is always linked to overcoming a certain number of challenges; the challenging element is indeed what distinguishes video games and what makes them so engaging and intriguing in the eyes of the player. The challenge has to be neither too simple, nor too difficult, but just slightly above the player's abilities, who in order to overcome it has to test his skills. It is no coincidence that in video games it is possible to recognize the concept of *optimal challenge* or *intrinsic competition*, the kind of challenge that is carried out with oneself rather than with others: it is a situation in which the difficulty level of the task responds to the skills of the individual, who is therefore aware of being able to obtain a positive result through his commitment and determination. Nevertheless, when the player fails, he can restart and try again, as the game always offers another possibility. Indeed, through the error, the player learns which actions he can take and which to avoid: it is estimated that the players spend most of their time making mistakes, but in contrast to what often happens in real life, failure does not produce a negative effect but, on the contrary, pushes the player to try again, until the goal is reached. This occurs because the video game represents a *safe place*, in which the error is not condemned, but it is instead necessary in order to obtain the desired result, in contrast to what happens at school, where usually the error has a negative connotation. To err, therefore, also seen as the chance to explore new possibilities and to run into the unexpected (Bocci,

2005): in video games, indeed, the individual has the opportunity to take risks and to dare, doing things that he would not do in real life.

In video games, indeed, the player places himself on purpose in a "stressful" situation in which he has to face unnecessary obstacles (Suits, 2005). Nevertheless, in this situation the player experiences what is known as *eustress*, the positive stress, which unlike the *distress*, the negative stress, generates pleasant and stimulating psychophysical sensations in the individual, who adopts an optimistic attitude and is motivated to overcome these obstacles, as he is aware of being in possession of the appropriate skills to face them. This phenomenon is inevitably linked to the experience of flow theorized by Csikszentmihalyi (1990), namely the condition that is generated when the individual is completely absorbed in a given activity, to the point that he completely loses the sense of time and space. This condition is characterized by the presence of several elements: complete concentration of the individual; clear objectives; distortion of time and space; appropriate skills to face the task; sense of control; intrinsic pleasure.

In the end, in video games the narrative element also plays a crucial role as it allows the player to be involved on an emotional level. Indeed, when the player gets passionate about the plot and he feels deeply connected to his avatar and to the other characters, his curiosity pushes him to want to proceed in the game to follow the evolution of the story. In contrast to what may happen with a movie or with a television series, in video games the player has the opportunity to choose first-hand the evolution of the story and the fate of the characters. This occurs especially with graphic adventures, one need only think of games like *Life is Strange*, *Beyond: Two Souls*, *Heavy Rain*.

Experimentation: unplugged design of a video game

Within the laboratory of Educational Technologies activated at the Degree Course in Primary Education Sciences of the University of Roma Tre, attended by students of the fourth year and held in March 2018, was tested the design of a video game in "unplugged" mode, a term with which we refer to all those activities, playful or not, that to be put into practice do not require electricity. In a more specifically didactic context, the unplugged mode can, in some cases, foresee the interaction between analogical supports and computational logic, for example by designing a game based on the use of the body and the surrounding environment and then reshaping it in a digital key. In our case, the majority of the students participating in the workshop – about seventy – were not familiar with either computer language or video game logic; many of them, moreover,

had a certain "distrust" towards video games, both as entertainment tools and with their didactic potential.

The aim of the Laboratory was to enable students, future teachers, to build (working in team) a video game environment that could be reproduced even in the absence of the digital devices on which it is usually implemented and through which it can be reproduced. This last circumstance can occur in many school complexes, unfortunately still lacking adequate structures and instruments. The educational and pedagogical mission of the Laboratory was also to allow future teachers to experiment in a protected environment, the university one, the video game principles applicable even in disadvantaged class contexts. The educational objective was to ensure that the students involved in the design of the game master the philosophy of gamification, so that they could take advantage of it wisely and consciously in their future classes. Indeed, we are convinced that the student's direct action and experimentation facilitates the acquisition of knowledge and skills that can be spent in the context of life, and that it is necessary to have opportunities for real action research to build the multiform and multifaceted teaching profession, with the aim of structuring a wide range of good educational practices that allow the teacher to select, from time to time, the most coherent and effective one in relation to the multiple and complex educational challenges.

We also focused our attention on the interaction dynamics developed within the working groups, in particular on the contribution of the individual cognitive profiles to the final project. Before the Laboratory was launched, students were asked to answer the eighty questions of the Self-Perceptive Questionnaire for the detection of cognitive profiles (Bocci *et al.*, 2016), a tool developed by the Research Group on Multiple Intelligences "Omnia Sunt Communia" on the model devised by W. McKenzie (2006). The Questionnaire has as its conceptual background the Theory of Multiple Intelligences by the American psychologist Howard Gardner, according to whom there is not a single intelligence, but a series of intelligences – linguistic, logical-mathematical, musical, visuo-spatial, body-kinesthetic, interpersonal and intrapersonal naturalistic – controlled by as many brain modules, responsible for specific performances. Each individual holds each of the above mentioned intelligences, but in a qualitatively and quantitatively different measure compared to the others, so much so that he possesses a specific and personal cognitive profile. The questionnaire, which was able to map the areas of strength and weakness of each individual, was used by the leaders of the Laboratory to create cognitively heterogeneous groups.

In line with I.M. theory, classroom work has involved multiple levels and plans. The delivery was as follows: "Designing, in groups, a video game using a storyboard with which to illustrate the plot, characters and levels

that will serve as intermediate objectives". The few students who had the appropriate technical skills had the opportunity to make a real video game through open source software. Once the design phase was completed, some pilot works would be chosen that would be unplugged by the remaining groups, simulating the various game situations provided in the storyboards. The request made to the groups evidently recalled the structure of Gardnerian intelligence, believing that the narrative plan and the visuo-spatial plan would be directly involved in the storyboard; the visuo-spatial and the body-kinaesthetic plan would allow to move wisely within the space in order to solve the educational puzzles; the musical one would have marked the single phases of the game, highlighting the most significant moments of the simulation; the logical one would have allowed the groups to elaborate effective strategies of the game; the inter and intrapersonal ones would have played the function of glue for the whole duration of the activities in a spiral of continuous negotiation between their own self and the other members of the team (and not only). The strength of such an experiment is its reproducibility with children, with whom future teachers will have to interact, regardless of the presence of specific technological aids.

Such an approach aims to be recursively inclusive in its very approach: the chosen theoretical background, that of the Theory of Multiple Intelligences, ensures the customization of learning, providing multiple approaches to knowledge and revolving around the strengths of the students involved, while the plasticity of the learning environment, which, as a creative laboratory, transforms itself into the scenario and setting of the game, gives the possibility to find new "glimpses" of functioning and, in accordance with the ICF model, more inclusive opportunities, since disability is nothing more than "a state of health in an unfavourable environment" (OMS, 2002). Moreover, the structuring of the simulated game, on levels of increasing complexity, strongly affects the motivation to learn because it leaves gaps in knowledge that the student has a desire to fill and is, by its very nature, challenging, as the progressive process towards the next levels requires the player a level of competence even slightly higher compared to the one in his possession (Malone, 1981). And it is the motivation, as many pedagogists, including Dewey (1965), have mentioned, that affects the direction and intensity of behavior.

Crossroads

In particular, here we report the work, characterized by a high level of complexity, of one of the group of the Laboratory, which has been chosen to be the sample of the experimentation. In order to create the video game,

the members of this group decided to use the software *RPG Maker* – a tool for the creation of role-playing video games – therefore all the scenes of the storyboard were made by using the screens of the software itself. Below we report the plot of the video game, called *CrossRoads*, created by the above-mentioned group:

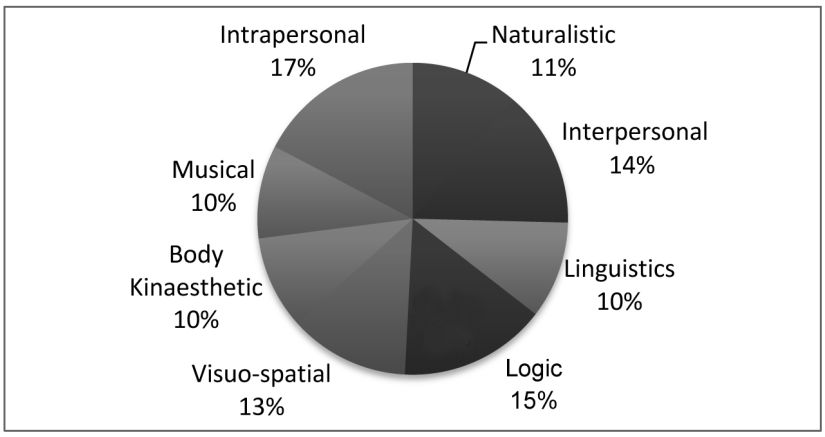
A young man wakes up on a strip of land isolated from the sea and has two choices before him: to escape to save himself or to investigate the reasons for his presence in that place. From this moment on, the story is split into two parts, which will allow the protagonist, according to his choices, either to discover the real motivations that led him to this place or to survive in that moment and in that place. Choosing to survive "Here and Now" will, however, lead the protagonist to repeat the same actions and choices an endless number of times, unless he surrenders to his fate and begins to understand the ultimate goal of this experience: discovering himself.

Through the Questionnaire, we examined the cognitive profiles of the members of the group chosen as sample (Tab. 1). The final score of each intelligence is obtained by adding together the points, attributed on the basis of a Likert Scale, derived from the ten items referred to each forma mentis. To make the analysis of the data easier, the graph representing the resulting intellectual profile of each member is presented, together with a final summary showing the areas of strength and weakness of the entire group. The aim is not so much to make the individual's data disappear from the whole, but to show how very different intellectual profiles can work together and encourage the creative process. The graph (Tab. 2), which represents the group's summary, shows that, overall, the group has a good intrapersonal and logical intelligence, while less developed appear linguistic, body-kinaesthetics and musical abilities.

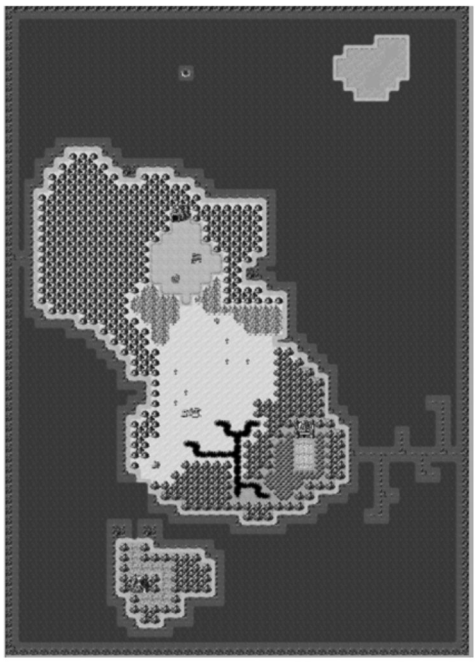
Table 1 – Cognitive profiles of each individual working group member

Intelligence	**M.P.**	**F.G.**	**L.F.**	**R.G.**	**G.G.**
Naturalistic	5,6	4,8	4,8	8.6	9
Interpersonal	7	6,2	8,4	8,2	7,8
Linguistics	5	7	4,2	5	5,2
Logic	7,6	5,4	7,2	7,4	7,6
Visuo-spatial	6,2	7,8	6,6	6,6	6,6
Body Kinaesthetic	4,8	4,6	5,2	5	4,8
Musical	4,8	7,6	4,8	5,8	5,4
Intrapersonal	8,6	5,8	8	8,4	9,2

Table 2 – Cognitive profile of the working group as a whole



From the video game "Crossroads":



World Map

Gaming map is composed by 3 parts:

- Solitary Island
- Central Island (composed by: *north plateau, southern valley* and *inland desert*
- Volcanic Island

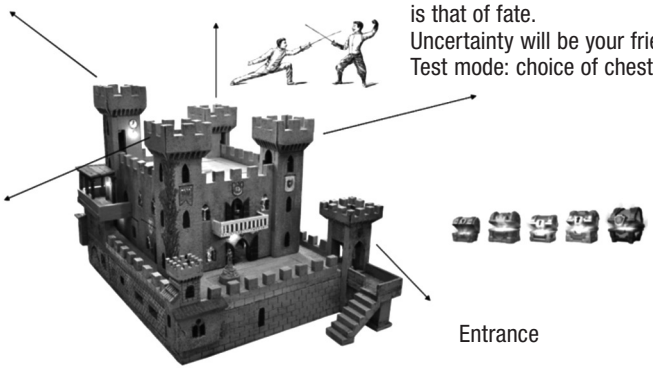
The castle of crossed destinies A place where those who are in search of their own destiny can enter. The castle is composed of four rooms (or towers), each of which is dominated by a different dimensional law. The inspiration for this dynamic is Caillois' "four dimensions of the game". The castle is protected by a spirit, which will guide the player through the challenges.

Ilinx Room
In this tower the law that dominates is that there are no laws.
Vertigo and drunkenness will be your friends.
Test mode: Reply to "senseless" riddles.

Agon Room
In this tower the law that dominates is that of competition.
One goal: to win.
Test mode: duel, challenge.

Alea Room
In this tower the law that dominates is that of fate.
Uncertainty will be your friend.
Test mode: choice of chests.

Mimicry Room
In this tower the dominant theme is fiction and imitation.
Test mode: imitate a sequence made by an Npc.



Entrance

VIDEO GAME CHARACTERS
Characters were defined based on Advanced Dungeons & Dragons 3.5 Alignment System

Some playable characters

– AX (FEMALE)

Alignment: CB (Chaotic Good)

Class: REBEL

– RYM (MALE)

Alignment: LB (good legal)

Class: MIXTIC (cleric)

Some Characters not playable

– ZUNI

Alignment: NB (Good Neutral)

Notes: Ancient spirit of the island. Before becoming a spirit he was a warrior. Its purpose is to help lost souls. It serves as a guide for the PG that you have lost and does not know who it is.
It proposes a riddle which, if solved, will give the possibility to proceed in history.

– PETRAS

Alignment: LB (Good Legal)

Notes: This is the ancient princess of the castle, lived between the twelfth and thirteenth century, who, forced to become a nun by her father, spent her life helping others. After his death, his soul became the guiding spirit of the castle so that it can help all those who enter to find their way out. The task of the game is to show the player the rules of the castle and its challenges.

Conclusions

In conclusion, as the final product showed, teamwork and cognitive heterogeneity allowed the construction of a complete artifact articulated in various levels. In line with the answers given to the Questionnaire, the students' strengths (intrapersonal and logical intelligence), through the bridging process, were used as supporting scaffolds for the execution of tasks related to other weaker areas (linguistic and bodily-kinaesthetic). The presence of a student, F.G., with a strong visuospatial intelligence allowed the elaboration of a complex and articulated map, with a spiral structure, and allowed to overcome the impasse caused by the request to graphically represent the storyboard, through the use of a user-friendly software by which students could create environments and characters digitally rather than by hand. This is an authentic inclusive and personalized process of problem solving, since through the variation of the learning environment and revolving around the cognitive peculiarities and strengths of each, the sample group has achieved the objectives of the Laboratory. The logical area, however, very strong in the group, allowed the development of interesting educational questions, also available in class with students, and references to other cultural artifacts (the reference of *The Castle of Crossed Fates* is to the novel of the same name by Italo Calvino).

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