A mapping of the kinds of work activities and other productive uses inspired by play or games

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Abstract— **This paper is about a theoretical study consisting in listing and positioning different kinds of serious uses derived or inspired by play or games. Indeed, since the beginning of the 2000s, the number of these forms has increased exponentially and it is becoming very complicated to find one's way through. In our opinion, there is currently a problem of distinction between the various serious forms derived or inspired by the practice of a playing activity and the design of a game structure. In this article, we try to bring a beginning of answer to this problem. To do this, we began by exploring the scientific literature dealing with these different forms. We started with the reference works that we reconsidered from this large variety of forms. Subsequently, we explored possible categorizations based on a limited number of variables. We were then able to draw two diagrams: one to represent graphically the categories identified according to the chosen variables, and another to present 6 combinable design process that can be followed to create any of these serious game or play categories.**

Keywords— *gamification; serious play; serious game; agile game; persuasive game*

I. Introduction

Over the past two decades, games, play and similar artifacts have become sources of inspiration for problem solving in many fields. These solutions can take different forms and can be understood according to one's interpretation by the terms "game" or "play", referring respectively to the physical and formal structure of game or to the activity of play. A few decades ago, the leading authors on play [1][2] considered that play as an activity, if it was: free, non-serious, outside of ordinary life, separated (from other real-world activities) in space and time, uncertain, unproductive, rule-bound and fictitious, and involving pretending. With these criteria, if a priori one of these characteristics is not respected, we can no longer speak of playful activity.

However, with the evolution of games and the emergence of forms of activities that can be called serious game or serious play these characteristics can no longer help us to qualify find ourselves among the activities qualified by their participants or promoters of games. In fact, already by their title and orientation the uses of serious games or serious play, like the practices of game activities for serious purposes or serious play, the "non-serious" characteristic of J. Huizinga [1] is, de facto, already excluded. With the other characteristics that still qualify a game activity in the sense of R. Caillois [2], there are other problems. Many serious games and serious plays are used to produce data or knowledge. In addition, in most cases, a manager of the organization concerned or a teacher imposes their use (e.g. when a teacher proposes to students to play a game as part of an educational activity). The activity is

therefore usually forced. There is also the case of games that explicitly refer to reality by trying to reproduce it in some of its aspects with precision (this is notably the case of training simulation games). On the other hand, designers of purely online digital games have implemented economic models that make the game activity profitable and therefore productive (in particular through subscriptions, the purchase of equipment or the professional game streaming activities).

An alternative to this type of problem could be to refer to work such as that of J. Henriot [3], who proposed to qualify a game also on the basis of its structure: if, from an observer's point of view, a device bears a strong resemblance to a game already recognized as such, then it can be considered a game. The game structure thus contains markers whose recognition allows an observer to identify a game. We consider these markers as elements that are part of one or more game structures that remind an observer by their presence of their game origin. By extension, we consider that there are also recognizable markers of non-play in the structure of devices or in the environment where a work activity is conducted.

Until about fifteen years ago, this type of qualification could be used, but since then, many devices with serious aims that are more or less similar to games have appeared. These are generally associated with the term "gamification". Even though in the early 2010s, a group of researchers [4] proposed a simple and practical diagram to take into account these new serious forms that are more or less similar to games and to situate them in particular in relation to serious games, the evolution of all these forms and the emergence of new ones have complicated the use of this diagram. Indeed, from now on, this schema seems to us to be much less easy to use, so varied are the applications and practices.

For example, we there are many hijackings of games like Minecraft for educational purposes (Minecraft Education), of the Tetris game for furniture design purposes (Tetrad Flad shelders for exemple), accessories (Tetris 3D modeler) or for the introduction to asymmetric cryptography (Cryptris). We have various agile games (intended to raise awareness or to support the implementation of agile methods such as Scrum), including in the case of Planning poker used to estimate the duration of the tasks to be performed in a team according to the use of a particular set of cards. There is also the Speed boat ou Sail boat that is a template presented as an agile game or an innovation game and whose objective is to accompany in a visual way the debriefing of a team so that it improves its practices. In similar registers, related to gamification, we also found it difficult to identify the positioning between gameful design and playful design of the model of S. Deterding et al. [4], several experiences of the program Fun Theory as: the

shopping carts with skateboard, the glass bottle container (bottle rank arcade), the sound garbage can, the musical staircase and a system based on the game Pong to make pedestrians wait before crossing at traffic lights.

In the same way, the number of recent articles proposing a state of the art of one or the other of the forms more or less related to the play/game and used for serious purposes ([5][6][7][8][9][10][11] ...) testifies to the increase of this diversity, as well as to the need to bring a light to it.

According to us, there is a problem of distinction which arises currently between the various serious forms inspired by play/games. So we tried to answer two questions: how to classify from a reduced number of variables these different forms and which design paths can be taken to conceive them?

To do this, we first tried to list these different forms from the scientific literature from the search engines Google Scholar and Semantic scholar. Thus, we have opted for a theoretical approach aiming at rethinking from our survey of the literature including notably the state of the art articles mentioned above. One of the fundamental articles that allowed 12 years ago to easily classify these forms was the diagram of S. Deterding et al [4]. Then, we start with a critique of the S. Deterding et al. Diagram (fig. 1) from our literature survey. We started by trying an adaptation of this diagram by renaming one of its two axes. After that, we proposed new variables to be integrated in a new diagram in order to be able to position many existing forms. We thus retain 8 disjunctive variables that allow us to draw a graph in the form of a logical diagram of L. Carroll [12]. Once this is done, we look at the areas in which we have been able to identify utility forms derived from the game. Finally, starting from a critique of this diagram relating to the polarity of the investments made, we then evoke the possible nuances between binary choices. We return to the initial question of their conception and the paths it can take. We retain 6 design directions, half of which can be combined, which we illustrate with a final diagram.

II. 4 CATEGORIES OF PLAY/GAME-INSPIRED UTILITY DESIGN

In the early 2010s, an enlightening schema proposed by S. Deterding et al [4] (Figure 1) allowed us to better distinguish serious games and gamified systems. With these authors, gamification is considered as a distinct design from games (complete and dedicated game structure) and playful design (activity design whose experience is playful).

From only two axes, these authors have highlighted a distinction between design borrowing partially or completely from play or game. With this schema, a gameful design or gamification is only an imperfect structure of which only constituent parts fall under those of game structures, but not its whole. A gamification is defined in this way because what is modified from the addition of ludic elements has been modified at the level of the structure and not of the experience proposed from the activity. This second axis allows us to distinguish gameful design from playful design. These differences appear clearly in the diagram (Figure 1), whose separations depend on two axes composed of two opposite ends: Gaming - Playing and Totality - Parts.
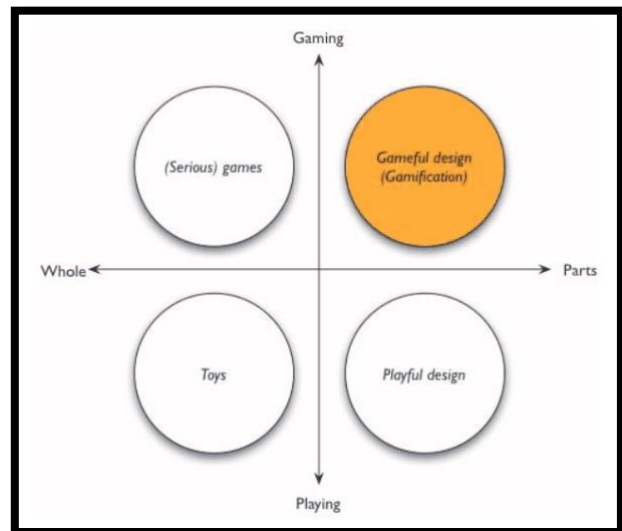

Fig. 1. "Gamification" between game and play, whole and parts [4].

With the schema of S. Deterding et al [4], we can position the best known of these categories is the one specifically called "serious game". According to this approach, ""serious game" describes the design of full-fledged games for non-entertainment purpose" [4]. Another characteristic of these games is that most of them are clearly named "serious game". This is therefore a claim of their designers and/or distributors, but it has the advantage of informing users about what they can expect, even if they may sometimes be disappointed by the proposed game structure. By extension, it seems that the activity corresponding to the use of a serious game is referred to by this same expression. Serious games and gamification designs are part of the same whole, distinct from each other by the fact that they correspond to a complete design for part in terms of the integration of game elements. In the lower part of the diagram, separated in the same way in terms of whether or not elements of play are partially taken into account, we have (serious) toys and playful design. A priori, in these cases, the activity and experience of play take precedence over the elements of structure. It seems to us that these aspects are more difficult to distinguish. We understand them as invitations to play that are partially or completely designed to do so. However, it is also difficult to differentiate a serious game from a toy used for serious purposes, especially if the latter invites to play.

The hijacking or adaptation of games (both tabletop games [13] and digital games [14]) that are purely playful, as well as the methodology of using toys, should be positioned in the spaces of the playing area. In these cases, we can also speak of play activities for serious purposes or serious play. However, the term "serious play" is not the only term used for activities in this category. There is also the term "serious gaming" which is also commonly used. These serious play or serious gaming activities are an inspiring set of solutions to many problems. For example, serious game construction workshops, the most famous of which are Lego serious play workshops, are used to achieve different objectives such as: team building, developing a common vision, building a schematic representation of a complex environment, generating ideas, etc. [15]. In these cases again, most serious play and serious gaming workshops are named as such. They have in common the need for supervision of the workshop by

a facilitator or trainer. Serious gaming is more like a detour of a game by adapting it without changing its structure (including the rules) in order to exploit its potential to achieve a serious goal. Serious play activities, on the other hand, correspond rather to the implementation of a formal method specifically designed to achieve serious goals and based on the use of game pieces (mostly construction pieces, as with Lego serious play [15] or MinecraftEdu [14]) or toys (for example figurines, as with Playmobil Pro). In this diagram the placement of activities based on a detour of game or game pieces. The placement of a Logo serious play type activity seems to us to be rather problematic. A priori, it is about the detour of game pieces associated with a method of using them specially designed to meet serious objectives. But can we still speak of a game experience in the implementation of these activities? This seems to us to be a problem with this diagram.

We thought of a simple solution to solve this problem by modifying S. Deterding's diagram [4]. Thus, we considered modifying it by changing the titles of the Gaming - Playing axis by the Serious gaming - Serious playing axis (figure 2). With this redrawing, we place in the upper part of the diagram the devices designed partially or integrally to be exploited as serious games, while in the lower part are the devices designed more in order to live a kind of game experience for serious purposes. As the diagram is made up of 4 circles, we have kept this aspect and qualified the two types of integral designs as very serious game and very serious play. The addition of the qualifier "very" serves to distinguish devices that can belong to only one of these two spaces. However, we find it difficult to design a serious game without considering a play experience. Some simulation games played very seriously can however correspond to a very serious game. On the other hand, very serious play activities seem to us more easily conceivable. Simulation games used for reflective purposes like wargames used very seriously by armies would fall into this category [16].

A mobile application like Zombies, Run! would also fall into this category, as it allows to create a complete sound environment inviting to the game while keeping the objective to accompany a jogger in his sport activity.

The integration in an environment of particular artifacts such as the Qball , which by its push ball aspect invites to play, but by its microphone and the contexts proposed for its use incites at the same time to a serious use, could correspond to these playfied experiences. In the same way, the animations of competitions carried out in a festive atmosphere (of the type challenges, hackathons) would also be located without this zone. But, as for the previous case, most of the partially gamified devices would belong to both gamified structures and playfied experiences.
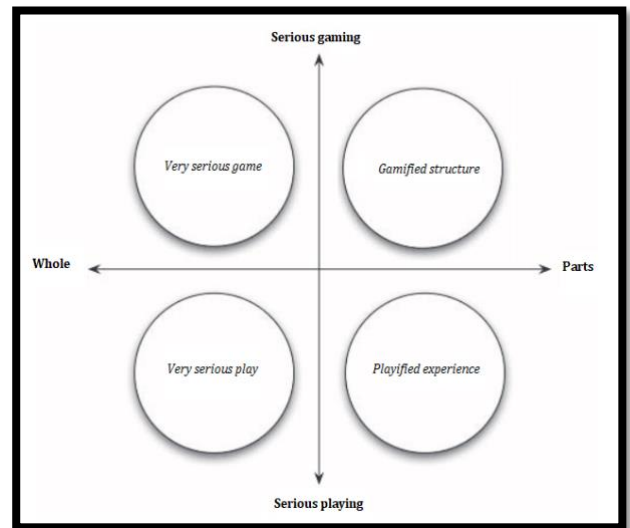

Fig. 2. Game-inspired and play-inspired forms of serious employment, between serious gaming and serious playing, whole and parts.

However, it can be difficult to distinguish if a device of this type is completely dedicated or partially dedicated to serious playing, or if it is a device conceived in extenso for this purpose, a complete or only partial modification, or if the invitation to play is limited. Thus, it does not seem obvious to us to classify several experiments of the Fun Theory program of which: the glass bottle container, the sound garbage can or the musical staircase. Because of these risks of confusion and the fact that this is only one reading among others of these categories that can also be combined, we propose to rethink it and define gamification and playfication as design processes that can be applied in a partial or complete way.

III. CHOICE OF 8 VARIABLES TO CATEGORIZE AND POSITION THE MAIN GAME-INSPIRED DEVICES

As mentioned in the upper part, there are many problems in using the schema of S. Deterding et al. [4] in order to have a vision of the main categories of serious jobs inspired or derived from games. In fact, S. Deterding et al. were not aiming at this goal, but wanted to clarify the concept of gamification. We completed our knowledge by searching via two search engines (Google Scholar and Semantic scholar) the scientific literature that was available to us using terms "taxonomy" (or: "classification", "classifying", "categorization", "mapping", "systematic review", "survey") and "serious games" (or agile games , "games with a purpose", "fames for a prupose", "serious gaming", "serious play", "gameful design", "playful design", "serious toys", "game based", "game inspired", "gamification", "gamified devices", "gamified systems"). As a result, we obtained 89 texts to be published between 2006 and 2022. Fortunately, we were aware of most of these texts.

Unfortunately very few dealt with a set of categories of different serious forms derived from the games and even less avoid focusing on the field of application as a category. Since a large part was already taken into account in the article S. Deterding et al [4] via two diagrams (fig. 2 and fig. 3). The second (fig 3) differentiates partly on the basis of 3 variables (using the game or not, playful interaction or not, extending the game or not).
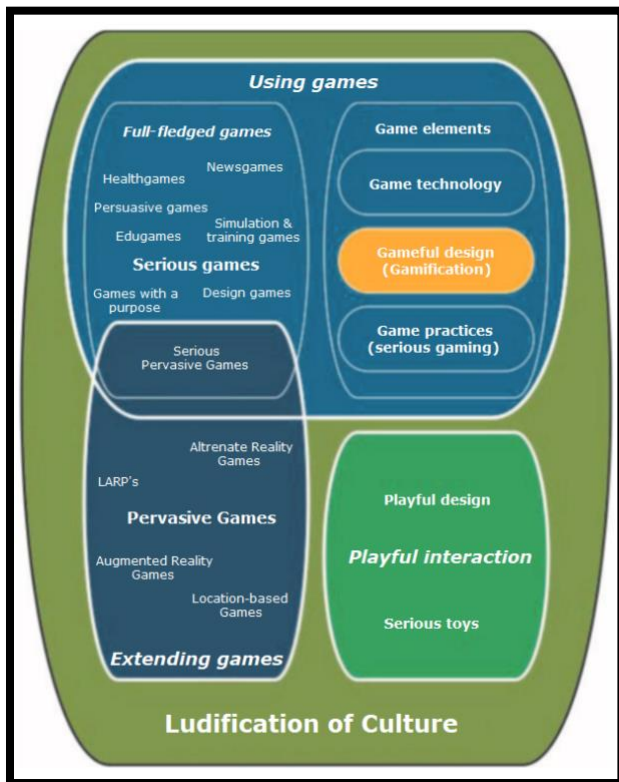
Fig. 3.   Situating "gamification" in a larger field [4]

We therefore used these patterns to develop our own classification model in which the type of device does not depend on its application domain. We wanted a simple method of classification, so we opted for disjunctive variables that are easy to identify. We established a matrix that allowed us to select a limited number of variables that allowed us to better distinguish the categories of serious devices inspired by play or games. This allowed us to use the schematization principle of S. Deterding et al. We chose the following oppositions:

- Level of playing: High vs Low

- Level of gaming: High vs Low

- The main recipient: User vs Someone else

- User information about the serious purpose: Transparent vs Opaque

- Educational purpose: Educative vs Non educative

- Persuasive purpose: Persuasive vs Non persuasive

- Device autonomy: Stand-alone device vs Device requiring and enabler

- Reality simulation: Simulation vs No simulation

It seemed simpler to us to consider high and low levels of gaming and playing, because the partial and complete distinctions (parts and whole) of the previous diagrams could be kept and the conception of serious play does not necessarily oppose that of serious games.

In the previous diagram, the devices that I. Bogost calls "exploitationwares" [17] are placed in the circle of gamified structures in the same way as the others that we have already mentioned. However, these devices, even with respect to those

of "pointification", have a more pronounced and pernicious characteristic; that of using game mechanisms in a hidden way to motivate users to perform one or more tasks. From this point of view, we believe that there is a hidden dimension that must also be taken into account when describing forms of gamification in order to better distinguish their variations. This amounts to considering, like other researchers, that these design elements of game forms correspond to gamified nudges [18][19], i.e. devices for guiding and manipulating users' behavior [20]. As such, they inherit the ethical and deontological flaws of these systems which, once the scheme is understood by the individuals concerned, become counterproductive. Thus, in order to avoid these types of pitfalls, systems that use games must be transparent about their objectives, just like nudges with a "benevolent" vocation, if they are not to be considered as manipulative elements of individuals [21]. This aspect does not appear in the model of S. Deterding et al. However, the purpose of the activity and the clarity of its objective is an important category of game-inspired devices: games with a purpose (GWAP). GWAP are devices most often designed to collect, classify data, annotate documents, serve as a learning system for artificial intelligence, etc. by motivating a maximum of contributions via a kind of game [6]. In contrast to explotationwares, most of them (including the famous Foldit) inform the user about the purpose of his contributions. The clarity or opacity of the goals sought from the game or gamified structure therefore seemed important to us to take into account.

Nevertheless, compared to more "classic" serious games, with GWAP the user is not the direct recipient of the data/information that he will contribute to collect or enhance. He is above all a contributor. This is a common feature that these devices share with exploitationwares since they are related to captchas [22], these software intended to verify if it is a human being who uses a Web interface while exploiting this test to collect data (for example, by clicking on photographs that present bicycles the user confirms his human nature and at the same time allows to collect data in view of the improvement of a photograph recognition software). For this reason, we have taken into account a variable based on the beneficiary of the use of the "game". This approach with this variable allows us to take into account the place of the user - player in relation to the serious game whose contribution is generally intended for him/her.

Two categories of serious games in particular stand out apart from those dedicated to collecting the data mentioned above: serious games intended to educate or train are very numerous, and so-called persuasive games intended to influence the player's behavior or outlook in his life outside the game [23]. Similarly, we have retained as a variable whether or not play and game devices are based on a simulation. Finally, we took into account the autonomy of the device or not, i.e. whether or not the device requires the support of a facilitator/animator in order to be implemented. The management of the Lego serious play method requires a facilitator. It is also the case of many wargames, serious escape games, agile games, corporate or institutional challenges...

Finally, GWAP, persuasive games, simulation games and training games were already present in the article by S. Deterding et al., but they were taken into account in the form of uses of serious games in another diagram dedicated to a broader vision of gamification (figure 3). We have taken up

the latter, but considering not their use, but their nature as a variable.

Concerning the digital or non-digital aspects of the games, we do not consider them immediately in our mapping diagram, because the corresponding variable would not be binary, since we can find purely digital serious games, purely physical games and hybrid games such as alternate reality or augmented reality games.

IV. MAPPING VIA AN 8-DIMENSION LEWIS CARROLL DIAGRAM

Our first goal is to present the different categories of serious games and other serious devices that are more or less game-like in an objective way that is clear enough to identify forgotten and busy areas. As Venn diagrams do not allow for 8 disjunctive variables to be easily taken into account, we have used L. Carroll's diagram [12] for 8 variables. This type of diagram also allows, compared to other multidimensional presentations, not to distort spaces by projecting 8-dimensional objects onto two dimensions. An 8-dimensional Carroll diagram works in a simple way. You have to identify each of the variables and the two values they can take. In this kind of diagram, the elements are placed according to the values of their variables, i.e. to the right or left of a segment, above or below a segment, inside or outside a rectangle. To clarify these elements, we have added an explicit legend to our diagram. In order to fill it in, you have to start by placing the elements opposite the segments and the largest rectangles first. The legend can be used for this purpose by reading it from top to bottom.

In order to make the reading easier and to avoid showing too large empty areas, it is also preferable to associate to the largest segments and rectangles the variables which have the most balanced distributions, in terms of number of elements, between their two values.

We have thus obtained the figure 4. This diagram sheds further light on the various serious devices more or less inspired by or based on play / game. Indeed, we started by placing the forms already referenced in the diagram and looking for the corresponding sub-categories if there were any. Thus, among the less playful and gameful forms (bottom left corner), we have a difference that appears between captchas and two forms of pointification that are distinguished by the fact of requiring or not human management: the basic pontification corresponds to an autonomous system that engages people without really inciting them to change their habits.

On the other hand, in the upper right-hand corner, we find the exploitationwares that we generalize into exploitation games. In a less autonomous version of exploitation games, we qualify these devices as serious playbour the activities animated by a facilitator or coach who aims at a serious objective without announcing it clearly. We can put in this category some experiences based on a game activity, in which the players are voluntarily kept in the ignorance of the real goal of the activity which can aim a market study or research in psychology, for example. When there is a will of persuasion or manipulation exercised via the play/game, we have the categories manipulation trickery game if it is a simulation, fool's game when it is not the case, but the device is autonomous and, confidence trick game when there is need of a facilitator (as for example in the case of Three-card Monte).

On the other hand, if the users are aware of the aims of the activity, whose main beneficiary will be someone else, we enter the closest area but included in the blue dotted rectangle. Here we find promotional games (e.g., from supermarkets) and advergames (game software for advertising purposes). When the devices concerned present a simulation of reality, we find persuasive games (autonomous) and persuasive play (requiring an animator as in the case of The Climate Fresk). Just below we have the GWAPs which inform about their objectives. We distinguish between collect by simulation games (with games like Foldit and Eterna) and collect games that do not use simulation. These games can be dedicated to data collection (as with the game Phrase detectives [24]) as well as to money with the organization of dedicated events whose objective is to collect funds (as the events of the type Games Done Quick).
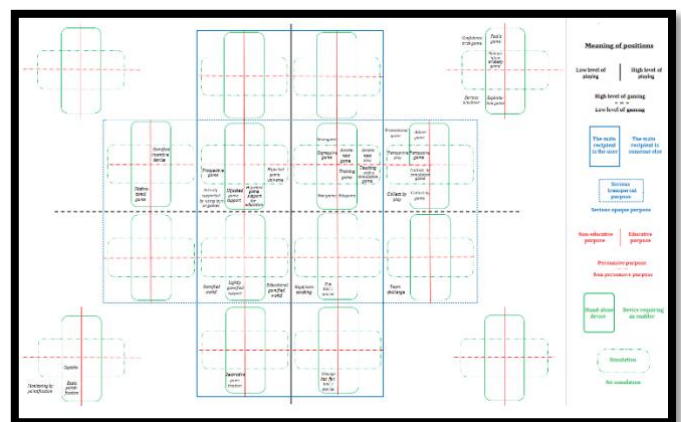
Fig. 4. An 8-dimension Carroll diagram presenting various categories of serious devices more or less inspired by play or games (see fig. 6, after references, for a larger view).

In the area below these categories, we have placed the challenges between teams. Here we find hackathons and other institutional or corporate competitions based on solving a problem for a third person. In the area just to the left of the challenges, we find the fun tools / devices (such as the Qball which invites play but remains a working tool that can be used without a companion) and happiness coaching.

In the area above these two categories, we have expressive games [25], newsgames, exergames, edugames, training games with or without facilitator(s) (including teaching with a simulation game). We also find awareness games and awareness play. Whether they are autonomous or not, the aim of these games is to make people aware of the interest of certain issues or knowledge by means of a form of simulation [26]. Compared to persuasive games, the players are the main recipients of the messages conveyed by the game.

In the area just to the left of these categories, we have games where the play aspect is less pronounced either, because the serious context takes precedence over the contribution of play, which is constrained and becomes very regulated, or because the game is only a setting borrowed to make an activity more enjoyable. Therefore we have included in this zone: prospective / foresight games (such as

prospective wargames and business wargames), activities supported by the use of toys or games (such as the case of Lego serious play workshops), hijacked game universes (such as proposed by Ubisoft by giving access to part of its game universes for teaching purposes as part of the Educationnal tours), hijacked game supports (such as planning poker, which uses cards but is not really played) and hijacked game supports for education (such as 3D Modeler, which, based on the model of Tetris, introduces the use of 3D printers [27]).

In the area just below, we find the gamified worlds, some of which are intended for teaching and which we have named simply educational gamified world (such as the one proposed by the Classcraft application), as well as the slightly gamified activity supports (such as the speed boat, which includes few game and play elements). Finally, a little more isolated we have motivational corporate games, gamified incentive devices, decorative gamification and strange but fun tools / devices.

We thus placed 37 different categories of forms borrowing from play or games for utilitarian purposes out of the 256 a priori are possible (2 possibilities for each of the variables, i.e. 28 possible combinations). However, even with all these possibilities, this mapping diagram seemed to us a bit limited, as it does not allow us to consider the design processes that lead to one or another form. Moreover, we also had to take into account the different variations between purely digital and physical games, knowing that some of them can exist on different media (for example, the Lego serious play method has recently been enriched with a hybrid version to be used online [28]). Thus, based on the hypothesis of a design continuum between the different forms of digital, gamified and playified games, we have obtained a new diagram that shows 6 combinable processes allowing to obtain all the forms mentioned above (Figure 5).

V. PROPOSAL OF A DIAGRAM PRESENTING 6 COMBINABLE DESIGN PROCESSES

Based on a reading of the dedicated literature and the assumption of a continuum between possible game structures, we propose a new schema with some hidden paths and dimensions of the design of these structures. For S. Deterding et al [4], "Gamification" is the use of game design elements in non-game contexts. However, as structural inputs, a design process taken to its limits can result in a toy or a game. We have moreover authors who have proposed for the design by gamification of artifacts halfway between tools and toys of toyification [29][30]. Another name that is given to this process present in the text of S. Derterding et al [4] is that of ludification, but the latter would extend to the cultural transformation of the environments concerned [31].

Another process of transformation of what we call work (to refer to all non-playful situations and activities) is that of playification. It would also consist in adding elements of play design, but as "a form of design that fosters playful, rather than gameful, behavior" [32]. Among the names given to this process or to processes that are fairly close to it, there is also that of ludicization/ludicisation which is used [33][34].

The process of digitalization transforms physical devices into digital devices or partially digital devices such as hybrid or phygital devices.

However, since these processes were oriented, it seemed obvious to us that inverse processes must exist. We therefore looked for them. Thus, the opposite process of gamification consists in starting from a game structure and ending, if pushed to the end, in a non-game device. The term degamification has been used in this sense [35] as the transformation of ludic activities into serious ones. However, this definition can refer to the opposite process of playification. As this process can result in the transformation of a game into a kind of tool, as opposed to toyfication, the term toolification of game has also been proposed [27]. It corresponds to: achieving non-game purposes in the redundant spaces of existing games. The term disengagement has also been proposed as an alternative to these expressions as a process of removing game markers and adding non-game markers to a game structure [36].
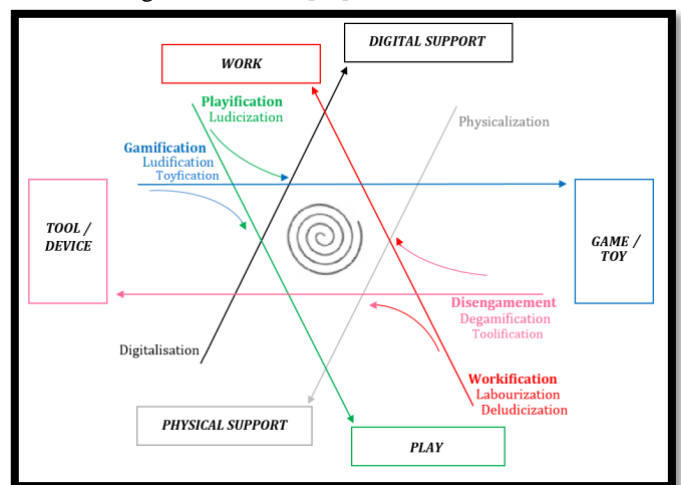

Fig. 5. 6 combinable processes for designing play/game-inspired utility devices and artifacts.

In the opposite direction of the playification process, we have first of all the expressions workification and laborization that have been proposed. The term workification has been used to describe the transformation of leisurely gaming activities into work-related practices (including the activities of professional game streamers) that can be called playbour [29]. The term laborization has also been proposed more explicitly to describe "the process of the permeation of play with work elements" [37]. The authors of this neologism have also added the expression work/play interferences to better account for the blurring that exists between different current practices. The spiral in the center of the figure serves a similar purpose by showing that these processes can be complementary and implemented one after the other, creating many hybrid forms between play and work. Finally, the term deludicization has also been used to describe these processes, but presenting it as a kind of synonym of degamification [38].

We can now compare with the help of the two diagrams the differences in positioning and design of the three Tetris adaptations already mentioned. Tetris 3D modeler, Cryptris and Tetrad flat shelves. Tetris 3D modeler uses the Tetris pieces and their positioning principle in an environment in 3 dimensions and thus allows the design of objects and

accessories that can be printed with a 3D printer. This device is classified as hijacked game support (applied to education, it is classified as hijajacked game support for education). Cryptis is based on Tetris without respecting the shape of the basic pieces, but it allows the player to manipulate the pieces while knowing the results obtained by an opponent who is an artificial intelligence. It contains enough play to be classified as an edugame. As it is associated with a 3D printer to be fully effective, it has undergone a partial physicalization process. Tetrad flat furniture has undergone a complete physicalization process. They are not easily manipulated in the sense of a game, but are shelves that have been given the look of the original Tetris pieces by giving them depth. As the objective is quite transparent and serves the user of its pieces, these pieces of furniture fall into the category of lightly gamified support.

Regarding the design paths, these three adaptations are inspired by the game Tetris and have followed a process of disengagement or toolification more or less extensive. They all lost some markers of the original game, even if it is lighter with Tetris 3D modeler and strongly pushed with Tetrad flat shelves. Non-game markers have also been added: the presentation of their use and the size of the pieces (which makes them less easily manipulated) for the Tetrad flat shelves, the 3D printing objective for the 3D modeler device and the reminders of the reality of the use of the cryptography process with Cryptris. 3D modeler and Cryptis have also undergone a process of workification or deludicization since their purely playful use is no longer.

VI. Conclusion

The 8-dimension Carroll diagram and the diagram of the 6 design processes allow us to find our way a little more easily among the numerous variations of devices and utilitarian artifacts derived or inspired by games. For example, in relation to the models of S. Deterding et al [4], we can distinguish games with a purpose from persuasive games and Edugames. In addition, if we go back to a few cases of experiments from the Fun Theory program that were problematic for us, we can better classify them. The bottle rank arcade and the sound garbage can do not really invite to play, but they are indeed the result of a gamification process. These two devices have an obvious incentive and educational intention. They are therefore to be classified among the gamified incentive devices. The musical staircase is classified in the category of fun but strange devices, since the purpose of inciting to physical exercise is not necessarily obvious for its users, and it is rather a process of playification that has been realized on the staircase from elements in reference to a piano, rather than to a game. The shopping carts with a skateboard are in the same category, although they have undergone a process combining playification and gamification. Finally, the system to make pedestrians wait before crossing the street, which is based on the game Pong, belongs to the hijacked game support category. This is a playification process that relies on the integration of a game.

Now, if we consider some of the successes among the forms inspired or derived from the games, we can reconsider some of these best known forms.

America's army is a first-person shooter (FPS) that was designed to help the recruitment of the U.S. Army from the 3D engine of a real game (Unreal Tournament). It has all the aspects of a video game. It falls into the category of persuasive games, however, for some players, when it first went online, its purpose was not transparent; it could then be classified as a manipulation trickery game. In terms of design process, it is inspired by digital games and the rest, it follows a process of workification or delucidization, since in terms of pure gameplay, it is still difficult to distinguish from other FPS. Moreover, since at the beginning, it was proposed as an arcade game and thus required a terminal, this device also underwent a process of physicalization, then of digitalization when it became an online game. Now, it is also used as a show game for e-sport competitions, which is also used for the communication of the US army. In its e-sport version, it can be classified as a promotional game.

Foldit is a game with the goal of discovering solutions for folding proteins so that they are more resistant to viruses. It is first a 3D modeling software that has been gamified and playified. It is a collect by simulation game. This game can be used online as a classic gwap to solve medical research problems or as a support for a teacher-led course (Foldit is too proposed with an educational mode). Depending on its use, it belongs to two distinct categories (the second is teaching with a simulation game).

Classcraft is an online role-playing game universe proposed to accompany an education. It is an emblematic educational gamified world. Its conception went through a partial digitization of elements related to education and gamification in terms of elements inspired by role-playing games.

Finally, the ball point game is an agile game whose goal is to raise awareness of the interest of conducting a design by course cycle that requires at least one facilitator and a hundred small balls. It is positioned among the awareness plays. It is not really a copy of a game. It has been designed as such. The balls invite to play, while the rules, the common challenge to all the "players" to make circulate according to the rules a maximum of balls in 2 minutes are markers of play. On the other hand, the systematic integration of briefings and debriefings to introduce the principles of agile methods are non-game markers. In terms of design path, this game is the result of a combination of playification and gamification processes.

We have just seen that the structure of the game and its design should be considered in the same way as the work / play situation. This can lead to problems in categorizing certain devices depending on how and when they are considered. In addition, we are aware of the limits of the proposed diagrams and of what they allow us to identify as areas still to be explored. For example, we wonder if we can't bring together under the same variable the distinction between educational and non-educational games on the one hand, and persuasive and non-persuasive games on the other. This would allow us to include another variable in our schema, but it remains to be determined. Perhaps the variable of games for utilitarian data collection would be appropriate. However, there are other variables that we have not yet fully explored. The fun or non-fun purpose of a device could also be considered, but this raises the question of recognizing what is fun or not. We also have the categories of games that can be considered (competition, construction, skill, course,

hidden information, ...) as possible complementary variables. We also have the cases of copies, detour and adaptations of games or, on the contrary, of existing devices in front of pure creations. This leaves us many possibilities to test while remaining aware of the appearance of new serious forms of "play". If the number of variables taken into account increases, we will have to consider another form of representation, but the presentation will lose some of its utility. It remains to test the reception of the scientific, professional and general public to the use of these variables and models. Will they find them easier to use in their understanding or design of serious devices inspired by play or games?

REFERENCES

[1] J. Huizinga, "Homo ludens: A study of the play‐element in cult", New York, 2008.

[2] R. Caillois, "Man, play, and games", USA, 2001.

[3] J. Henriot, "Sous couleur de jouer", Paris, France, 1989.

[4] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: defining gamification", in Proceedings of the 15th Int. MindTrek conf., Vienna, AUT, 2011, pp. 9-15.

[5] J. Krath, L. Schürmann, and H. Von Korflesch. "Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning", Computers in Human Behavior 125, 2021, pp. 1-30. [10.1016/j.chb.2021.106963]

[6] R. L. S. Díaz, G. Rovelo Ruiz, M. Bouzouita, and K. Koninx. "Building blocks for creating enjoyable games—A systematic literature review", International Journal of Human-Computer Studies 159, 2021, pp. 1-17. [10.1016/j.ijhcs.2021.102758]

[7] K. Seaborn, and D. I. Fels, "Gamification in theory and action: A survey", Int. J. Hum. Comput. Stud., 74, 2015, pp. 14-31. [10.1016/j.ijhcs.2014.09.006]

[8] A. Medlar, and D. Głowacka "Game over? A review of gamification in information retrieval", ACM SIGIR Forum 55 (2), 2021, pp. 1-18. [10.1145/3527546.3527551]

[9] S. Warsinsky, M. Schmidt-Kraepelin, S. Rank, S. Thiebes, and A. Sunyaev. (2021). "Conceptual ambiguity surrounding gamification and serious games in health care: literature review and development of game-based intervention reporting guidelines (GAMING)", Journal of Medical Internet Research, 23(9), e30390, 2021. [10.2196/30390]

[10] G. Rodríguez, P. C. González‐Caino and S. Resett. "Serious games for teaching agile methods: A review of multivocal literature", Computer Applications in Engineering Education 29(6), 2021, pp. 1931-1949. [10.1002/cae.22430]

[11] R. Hammady, and S. Arnab "Serious gaming for behaviour change: A systematic review, Information 142, 13(3), 2022, pp. 1-27. [10.3390/info13030142]

[12] A. Moktefi. "Lewis Carroll's Logic", in D. M. Gabbay and J. Woods (dir.) Handbook of the History of Logic, Vol. 4, 2008, pp. 457-505.

[13] A. Bourguilleau, P. Lépinard, and N. Wojtowicz. (2020). "Wargames for training future managers", Management & Datascience 5(1), 2020.

[14] G. Ekaputra, C. Lim, and K. I. Eng. (2013). "Minecraft: A game as an education and scientific learning tool", Proceedings of the Information Systems International Conference (ISICO), 2 – 4 December, 2013, pp. 1-6.

[15] S. Blair, M. Rillo, and Partners, "Serious Work: How to facilitate meetings, and workshops using the Lego Serious Play Method", 3th ed., USA, 2016.

[16] M. B. Caffrey. "On wargaming: How wargames have shaped history and how they may shape the future", Naval War College Press, Newport, 2019.

[17] I. Bogost, "Why Gamification is Bullshit", in S. P. Walz, and S. Deterding (Eds.) The gameful world: Approaches, issues, applications, USA, 2015, pp. 65-80.

[18] D. O'Sullivan, I. Stavrakakis, D. Gordon, A. Curley, B. Tierney, E. Murphy, ... and A. Becevel. "You Can't Lose a Game If You Don't Play the Game": Exploring the Ethics of Gamification in Education, 2021.

[19] S. Schöbel, M. Schmidt-Kraepelin, A. Janson, and A. Sunyaev. "Adaptive and Personalized Gamification Designs: Call for Action and Future Research", AIS Transactions on Human-Computer Interaction, 13(4), 2021, pp. 479-494.

[20] R. H. Thaler, and C. R. Sunstein. "Nudge: Improving decisions about health, wealth, and happiness", Penguin, 2009.

[21] P. G. Hansen, and A. M. Jespersen. "Nudge and the manipulation of choice: A framework for the responsible use of the nudge approach to behaviour change in public policy", European Journal of Risk Regulation 4(1), 2013, pp. 3-28. [10.1017/S1867299X00002762]

[22] S. Aggarwal. "CAPTCHAs with a Purpose. Human Computation", AAAI Publications, Workshops at the Twenty-Sixth AAAI Conference on Artificial Intelligence, AAAI Technical Report WS-12-08, The AAAI Press, Palo Alto, California, 2012, pp. 61-68.

[23] I. Bogost. Persuasive games: The expressive power of videogames, The MIT Press, Cmabridge, 2010.

[24] C. Madge, R. Bartle, J. Chamberlain, U. Kruschwitz, and M. Poesio. "Incremental game mechanics applied to text annotation", In Proceedings of the Annual Symposium on Computer-Human Interaction in Play, 2019, pp. 545-558.

[25] S. Genvo. "Defining and Designing Expressive Games", Kinephanos, Journal of media studies and popular culture april, 2016, pp. 90-106.

[26] M. Mortara, C. E. Catalano, F. Bellotti, G. Fiucci, M. Houry-Panchetti, and P. Petridis. "Learning cultural heritage by serious games", Journal of Cultural Heritage 15 (3), pp. 318-325, 2014. [10.1016/j.culher.2013.04.004]

[27] K. Kurihara. Toolification of games: achieving non-game purposes in the redundant spaces of existing games, Proceedings of the 12th International Conference on Advances in Computer Entertainment Technology, 2015, pp. 1-5. [10.1145/2832932.2832965]

[28] S. Blair. "How to Facilitate LEGO Serious Play ONLINE: New Facilitation Techniques for Shared Models and #Covidsafe Face-To-Face", Promeet, 2020.

[29] M. Törhönen, L. Hassan, M. Sjöblom, and J. Hamari, "Play, playbour or labour? The relationships between perception of occupational activity and outcomes among streamers and YouTubers", Proceedings of the 52nd HICSS, 2019, pp. 2558-2567.

[30] M. Thibault, and K. Heljakka. "Toyification. A Conceptual Statement", 8th International Toy, 8th International Toy Research Association World Conference, Jul 2018, Paris, France, 2018, pp. 1-8.

[31] J. Raessens. "Playful Identities, or the Ludification of Culture", Games and Culture 1(1), 2006, pp. 52-57.

[32] E. Márquez Segura, A. Waern, L. Márquez Segura, and D. López Recio, "Playification: the physeear case", Proceedings of the an. Symp. CHI PLAY, New York, 2016, pp. 376-388.

[33] E. Sanchez, S. Young, and C. Jouneau-Sion. "Classcraft: from gamification to ludicization of classroom management", Education and Information Technologies 22(2), 2017, pp. 497-513. [10.1007/s10639-016-9489-6]

[34] S. Genvo. "Looking at the history of video games through the prism of ludicisation processes", Kinephanos, Journal of media studies and popular culture january, 2014, pp. 119-134.

[35] I. Mosca, I. "+10! Gamification and Degamification", GAME The Italian Journal of Games Studies 1(1), 2012, pp. 77-89.

[36] S. Goria. "Methods and tools for creative competitive intelligence", John Wiley & Sons, London, 2017.

[37] S. Fizek, and A. Dippel. "Laborious playgrounds: Citizen science games as new modes of work/play in the digital age", In R., Glas, S., Lammes, M., de Lange, J., Raessens, and I., de Vries (Eds.) The Playful Citizen: Civic Engagement in a Mediatrized Culture, Amsterdam University Press, 2019, pp. 255-271.

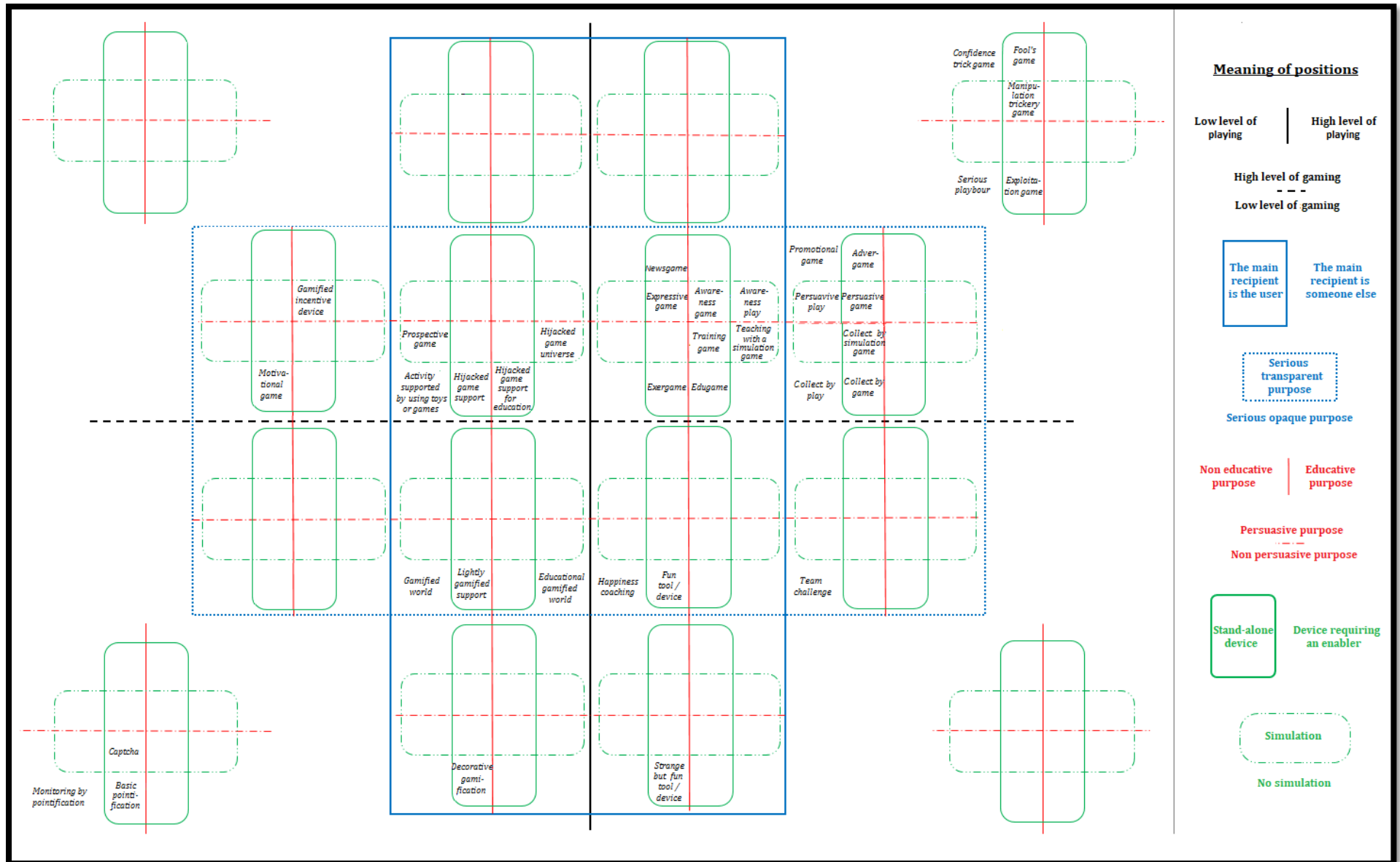[38] G. Brougère. "Paradoxes of gamification", In S. Le Lay, E. Savignac, J. Frances, and P. Lénel (Eds.) The Gamification of Society, vol. 2, John Wiley & Sons, London, 2021, pp 4-18.

Fig. 6.   Enlarged view of fig. 4.