Games as Socio-Technical Systems: Interdisciplinary Infrastructure for a Pedagogy of Play

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Abstract: In the search for a comprehensive framework to structure and instrumentalize a Pedagogy of Play, the present article explores the ludic phenomena from an interdisciplinary perspective, integrating relevant knowledge from multiple sources and complementary epistemologies. As a result, a socio-technical framework of play and games is built, described and exemplified across different cases, over a continuous territory that performs in terms of multiple scales and complexities. The overall intention is not to normalize games, but to integrate more and diverse playful interactions within our everyday lives; not only within basic education but across academic and professional life: an exertion driven by a genuine search to learn from each other and supported by a versatile set of tools. By approaching games as the tangible materialization of play, therefore delegating the material embodiment of whatever comes out of our creativity, to an active learning practice inspired by our curiosity, and that of whom we collaborate with. To conclude, the article discusses and reflects upon the political and aesthetic implications of the presented framework, highlighting the importance of attitudes and narratives that complement conventional study programs by suggesting new ways to approach pre-identified, yet open spaces.

Keywords: Game based learning, Contemporary studies, Interdisciplinarity, Socio-Technical systems

1. An Polysemic Playscape

As an introduction for the socio-technical framework to approach the ludic phenomena from a pedagogical perspective and before we look into what has been written about the subject, we shall begin by looking into play and games from an etymological perspective:

While in English and Portuguese there are two completely different words: play and game, and *jogo* and *brinquedo,* respectively; German, Spanish and French use one word interchangeably. In English, the word game comes from *gamen*, meaning amusement and pleasure; it is related to gambling, to the Swedish word *gamman* (mirth, merriment) and the Icelandic *gaman* (fun). Play on the other hand comes *plæġa*, which is associated with movement, exercise and festivity, sharing the same root with the word applause.

The Portuguese word *brinquedo* means game and comes from *vinculum* which means connection. *Jogo* comes from the Latin root *iocus* that is also present in the words joke and jewelry. It is related to the French word *jeux* and the Spanish *juego,* that can refer either to the game artifact (*jouet* and *juguete,* which means toy) as well as to the action of playing with it (*jouer* and *jugar,* respectively).

In German, as in other Germanic languages (such as Swedish, Danish and Dutch) the base word is *Spiel*, which also means to talk extravagantly. This term has the same performative implication as in English: fair play, to play music, a theater play, etcetera

1.1 Instinctive Play: Games as Imitation of Life

The study of play has been enriched by the fact that it is present not only within human societies, but in other animals as well. Since the end of the XIXth century, Karl Gross (1988) identified in most mammals and other animals like birds, attitudes of self-exhibition, imitation and decoration that he described as conscious self-deceptions related to developing social abilities such as nursing, mating, exploring, hunting and ruling.

As representations of real-life situations, the fun of games remains neither on the fidelity nor accuracy by which players enact their reality, but by the extent by which they can test alternative situations that otherwise would be too boring or too dangerous. By playing, children learn to express their feelings in a balanced way, through lively languages that are especially important in the early stages of their development as social individuals, in which verbal language by itself is inadequate; it is therefore fundamental for the growth and autonomy of any person (Piaget, 1962).

1.2 Transformative Games: Play as Safe Space

As an attitude towards exploration, play lowers the stakes by which players dare to take part in non-conventional situations. By playing we learn about the consequences of our actions and are able to apply those learnings into real life scenarios: from the protective frame of a rollercoaster, to the psychological bubble around children's play, the social contract that enables players to act differently from what they would, was called by Huizinga

(1957), the 'magic circle' of games. It is within this circle of trust that play happens, as players feel safe to express themselves freely. Moreover, since nobody can be forced to play, games enable safe zones, limited to a certain amount of choices, that players define the rules that govern them, responding to their own needs, inclinations, incentives, and motives to act (Vygotsky, 1976, pag. 537). Playing games allows them to make sense of their surroundings, as they explore and discover the playscape along their own desired rhythm, while avoiding the danger of risking too much.

Emancipated play enthusiasts often have more room to experiment and personalize different mediums of choice: art, performance, parody, simulation, dérive and hacktivism become playful strategies by which it is not only possible, but also fascinating to negotiate between conventional and emergent forms of communication (Flanagan, 2009). Trustworthy play involves genuine self-emancipatory experiences that give players the agency to engage in creative dialogue. In search of their freedom, as they acknowledge themselves as actors, not merely subjects, they coordinate and mobilize in a collective struggle to acknowledge their own destiny, forging common identities and a sense of belonging.

1.3 Therapeutic Play: Games as Remedy

Even if the positive influence of digital games on people's well-being is still unclear (Johannes, *et al*, 2021), other playful activities such as sports and laughter have been proved to be healthy as they generate direct and spontaneous stimuli through which players produce endorphins that contribute to their well-being (Louie, Brook and Frates 2016).

Moreover, games designed with explicit therapeutic intentions have been proved to contribute to mental and physical health, as they speak to the unconscious by creating meaningful engagement, evocative relationships and ultimately changing players behavior (Forgeard and Elstein, 2017; Rusch, 2020). These playful dynamics tend to be based on psychological resonance rather than on imposition or force, therefore maintaining positive attitudes that persist beyond the play time, providing an antidote to boredom (Homeyer and Morrison, 2008) and consequently "freeing the mind from the bonds of imitation" (Kandinsky 1947).

1.4 Educational Games: Play as Didactic Experience

By interacting through games, what Fröbel (1895) called ´gifts´, Vygotsky (1976) ´pivots´ and Winnicott (1951)

´transitional objects´, an educational experience is turned into self-learning practices by which players make their own knowledge, learning what they need, at their own pace (Farnè, 2005). As pedagogical devices, games may be directed by intents that relegate the traditional autotelic character of spontaneous play to an strategic objective: generally setting the correct framework to facilitate learning, not as mandatory but rather as open environments for self-directed adventures.

As Italian pedagoge, Roberto Farnè points out, the games we play entail our first experience of political education, as they require us to assume roles, follow rules, experiment with power, transgress limits, manage conflicts and make decisions within the limited space of action that concern any playscape. By playing together, we build formal and informal approaches to local ´policy making´ by which we represent and constitute communities, developing a group identity and a sense of belonging.

The same flexibility that defines children's play enables teachers and learners to interact using custom-made prototypes that require both sides to apply local foundational knowledge into real life situations. Sometimes explicitly, sometimes surreptitiously, games are insightful vehicles to learn about our own behavior and personality, as they allow players to imagine, test and reflect upon their priorities (Fink, 2003).

1.5 Cultural Play: Games as Evidence of Material History

Johan Huizinga (1957) argued that culture itself can be described as an emergent property of play and Roger Caillois (1958) described games as witnesses of the civilizational process, present in every realm of culture. As nobody can be forced to play, the chance that any game might be played relies on its coherence with the political ideology and social norms of the players; therefore, games are inherently related and influenced by the cultural background where they are designed, produced and played. At the same time, the materials and processes used to build each game reveal the cultural conditions in terms of technological dexterity, material availability, as well as visual references and cultural concerns of both the players and the designers (Avedon and Sutton-Smith, 1971; Spanos, 2021).

Since games are perceived as innovative, fun and attractive, they have a fleeting flexibility that makes them a great vehicle to spread into new cultures, transporting cultural elements across borders, while at the same time

keeping their characteristics together. Similarly to games, carnival, festivals and parties are arenas for cultural exchange characterized by spontaneity and absence of reflection, able to penetrate the spiritual structure of people even more than other 'respectable activities', such as politics and arts (Portilla, 1984).

As evidence of the material culture, games tell about the past in a more democratic way than other sources, as Spanos (2021, p.32) points out: "Object-based history is not solely 'written by the winners', as we tend to say for history in general, usually meaning exactly that texts are composed, edited, censored or even erased from records and memory according to the needs and plans of those in power [...] But the material world also keeps visible (and thus studyable) this part of past life, interaction and development that has not been evaluated by the 'winners'".

1.6 Gamification: Play as Bait

Within design research, playful activities such as building modules, clay modeling and collages can be regarded as generative research probes that situate the research subjects within experiential situations in which people tend to disclose creative behaviors and share privileged information that would not be accessible by means of traditional research methods (Sanders and Stappers, 2014).

While games may empower players to resignify their experiences, it is also true that they can be highly addictive and even used for exploitation. It is worth a look at Flusser (1999) notion of playing without being aware of it, as he frames limits, when "seen from the inside, they are taken for granted; seen from the outside, they are man-made".

A similar hunch may be felt while doing taxes, visiting an unknown city or playing games such as Candycrush (King, 2012) that use gamification knowledge to make people feel frustrated and willing to pay to get to the next level. In contemporary words, even if Artificial Intelligence algorithms seem like a breakthrough technology, it is important to question the biases by which games and any other sort of technology reproduce and implement the same violence of their designers and developers (West, et al. 2019).

1.7 Surreal Games: Play as Resistance

In order to question the metaphors of most mainstream games, built on capitalist values such as centralization and supremacism, Trammell (2020) calls to consider a more inclusive and reparative definition of the term by looking beyond the fun side of games and discussing how play has been historically used as a tool of subjugation that justifies objectivation and exploitation. By playing creatively players are able to rethink the metaphors behind games and subvert their rules, opening new means to issue gender, racial, ethnic, language and class inequities; to examine how power and social change is actually orchestrated, transgressively relying upon direct action that engage aesthetical and political matters (Flanagan, 2009).

From the liberation interest of surrealists like Breton and Soupault, to the critical modes of inquiry of play research, games entail an invitation to question the status quo and to experiment other possibilities beyond the conventional, winning or losing outcomes. Borrowing from dreams, children's games and poetic reverie, Jodorowsky (2007) finds games as stratagems for self-discovery, as they break the illusion of logic and recover imagination, breaking free from reality, they unravel the secrets of the human soul that may provide "keys to unlock the door to the unconscious and to release the visual and verbal poetry of collective creativity" (Gooding, 1991, p. 10).

1.8 Recursive Play: Games as Evolving Systems

From a systemic approach, games can be studied as simple artifacts composed of limited numbers of pieces and instructions that can be listed linearly. As formal systems, games are essentially logical structures that can be coded in mathematical language. The most common applications of these are video games, which rely on audiovisual and hyper-textual interactions, mediated by computer algorithms that are constantly evaluating the behavior of the players (Juul, 2001; Salen and Zimmerman, 2004). The same algorithms that limit the players' interaction, *are* in fact the game, as they dictate what can and can't be done within.

However when played, games become complex and inherently nonlinear as they depend on decision-making. From this perspective, it is possible to identify games as the only form of media where the audience has the chance to interact and actually define the outcome. Beyond their anatomy (whatever a game is made of), their emergent properties result from a second order of consequences that may not have been planned by their designers, if not even better from what it was originally expected (Silveira Duarte, 2015). Games as agents are no longer simple toys nor motionless lines of algorithms, but open, sensitive and recursive systems that adapt

to the players' dynamic experience. Evolved along centuries of play, games can be sorted over different lineages of families, types and genres (Klabbers, 2006; Sosa Compeán, 2017)

2. The Socio-Technical Framework of Play and Games

The following section integrates the different perspectives previously addressed, towards an abductive leap into an overlook that combines these ideas into a comprehensive framework to think of play and games as a

continuous territory. As incomplete as this may be and due to the incapacity to draw a normative description of the ludic fenomena, the socio-technical perspective shall be considered as a open model, as it reflects the two fundamental states at the basis of education: on the one side, the sensitive and spontaneous immersion into the chaos of the natural world and on the other side, an intentional and structured reflective assimilation process that leads to significant learnings (Farnè, 2005).

2.1 The Social Dimension of Play

On its social dimension, play can be sorted by the scale of the space where it happens. The categories depicted in table 1 identify the attributes and representative examples of different games along a spectrum that begins at micro scale with local activities (promoted by internal and perceptive attitudes), and extends towards macro experiences (international relations with political and economic implications). These categories are described as follows:

- Perceptual play encompasses mental and physical activities. It is mostly individual, receptive and reflective. Some examples of these are meditative awareness, physical exercise, listening to music and attending parks, movie theaters and art shows.
- Creative play entails the experimental conceptualization, representation, captivation and manipulation of our surroundings. It is exercised, embodied and expressed through singing, storytelling and dancing or by interacting with objects, such as puzzles, toys, paper, pencils and computers.
- Interpersonal play extends the magic circle of games to a social space in which two or more people interact. As well as creative play, it can happen only among people (e.g. role playing, wrestling and racing) and around playful artifacts (as in chess, video games, football and other object mediated games and sports).
- Cultural play relates to playful activities that happen within particular communities, such as children's play within a kindergarten, local myths, rituals and legends (either urban and ancestral tribes) and folkloric celebrations related to holidays and local traditions. It is within this scale that most businesses operate, as companies let their employees play, they may feel more at ease to work, explore and create cool stuff.
- Finally, on its global scale, the magic circle of games can be identified at international scales by looking at sports associations such as FIFA and the Olympics, beauty contests and online gaming networks. Although some authors may argue that play experience decreases as the players become professional), it is also possible to identify play elements beyond the stadiums and off the court, but as strategic attitudes with economic and political implications.

Table 1. Social dimension of play listed from micro to macro experiences

Microplay	Perceptual	Creative	Interpersonal	Cultural	Global	Macroplay

2.2 The Technical Dimension of Games

On its technical dimension, we can refer to games as the tangible and coherent representation of play, therefore, sorted from simple conceptual models, to complex technological infrastructure. In relation to Salem and Zimmerman degrees of complexity (2004), Table 2 avoids fixed and chaotic systems as they may not reach out the category of games, and extend their periodic and complex systems' view into five new categories that refer to the intricacy of their technical requirements:

- Conceptual games focus on interpreting, representing and creating new meaning. Some examples of these are solving riddles, drawing, reading, writing poetry and other wordplay such as tongue twisters.

- Corporeal games tend to direct the attention to the players' bodies. Either individual or not, these games involve physical training. Running, wrestling and dancing, as well as most athletic sports can be identified in this category.
- Material games tend to happen around relatively simple objects such as clay, dice, balls, or decks of cards. As they may also be relational, their emphasis relies on the objects, rather than on the relationship with other players. Examples of these are most toys and dolls, collectables and simple computer games.
- Relational games rely on the interaction between players. Multiplayer video games, as well as running an art gallery or working in Diplomacy can be studied as relational games, since gamers, artists and diplomats tend to act on particular domains aside from reality with relative freedom to plan and execute their own strategies.
- Systematic games are structured around replicable processes, methods or programs. These can be played in cyberspace as well as in tangible spaces and social organizations. Examples of these are surfing the web and owning a football team. These are not based on scattered elements, but on the possibility to intervene on the same structures where games operate.

Table 2. Technical dimension of games listed from simple to complex implementations

	Conceptual	Corporeal	Material	Relational	Systematic	
Simple games						**Complex games**

In order to combine these dimensions into a comprehensive landscape, Table 3 situates different playful activities across a continuum space that visualizes the socio-technical study of play and games. These examples do not aim to impose a quantitative definition of the scales, nor a normative description of the chosen examples, rather than visualizing the diversity of examples. While the instances in the bottom left corner are normally played individually, the examples on the top right corner tend to be the result of collective play, sometimes competitively, but not always.

Table 3: The socio-technical matrix of play and games with representative examples

		Technical dimension of games				
		Conceptual	**Corporeal**	**Material**	**Relational**	**Systematic**
	Global	Academia	Miss Universe	TV industry	Diplomacy	MMOs FIFA
Social dimension of play	**Cultural**	Myths Legends	Cosplay	Collecting stamps	Owning an art gallery	Boyscouts
	Interpersonal	Riddles	Wrestling Choir singing	Boardgames	Flirting Dancing	Couchsurfing
	Creative	Poetry Sudoku	Pantomime	Sculpting Solo music	Storytelling	Lego Minecraft
	Perceptual	Reading Meditation	Yoga Gymnastics	Attending an art show	Hanging out	Web surfing

It is worth noting that the experience around a TV is completely different for the producers of the show than for the audience. The socio-technical matrix study shall prevail the perspective of the players, which allows us to understand that for one game, there can be different play experiences: as in Soccer where there are different rules for the team owners as for that of the athletes. Table 4 illustrates the case of playing chess in different playscapes:

- A. Chess is not completely conceptual, only if we think of it as a formal system.

- B. Playing chess with a friend is mostly an interpersonal experience, that is also corporeal. Local contests that gather youngsters to test their strategic abilities.
- C. Yoko Ono's only white chess set for players to realize there is no need to compete.
- D. The work of an artisan who crafts a new set of chess
- E. Local contests that gather youngsters to test their stragegic abilities.
- F. The interaction with a smart set that moves automatically while the contestant is abroad (as the technical complexity of the game is high, the interaction of the players with the game claims to be rather simpler).
- G. A father teaching his daughter to play (the complexity relates to keeping the child's attention).
- H. The concentration of Gasparov while playing against IBM's Deep Blue.
- I. A social chess network that matches international players and ranks their performance.

Table 4: The socio-technical study of chess
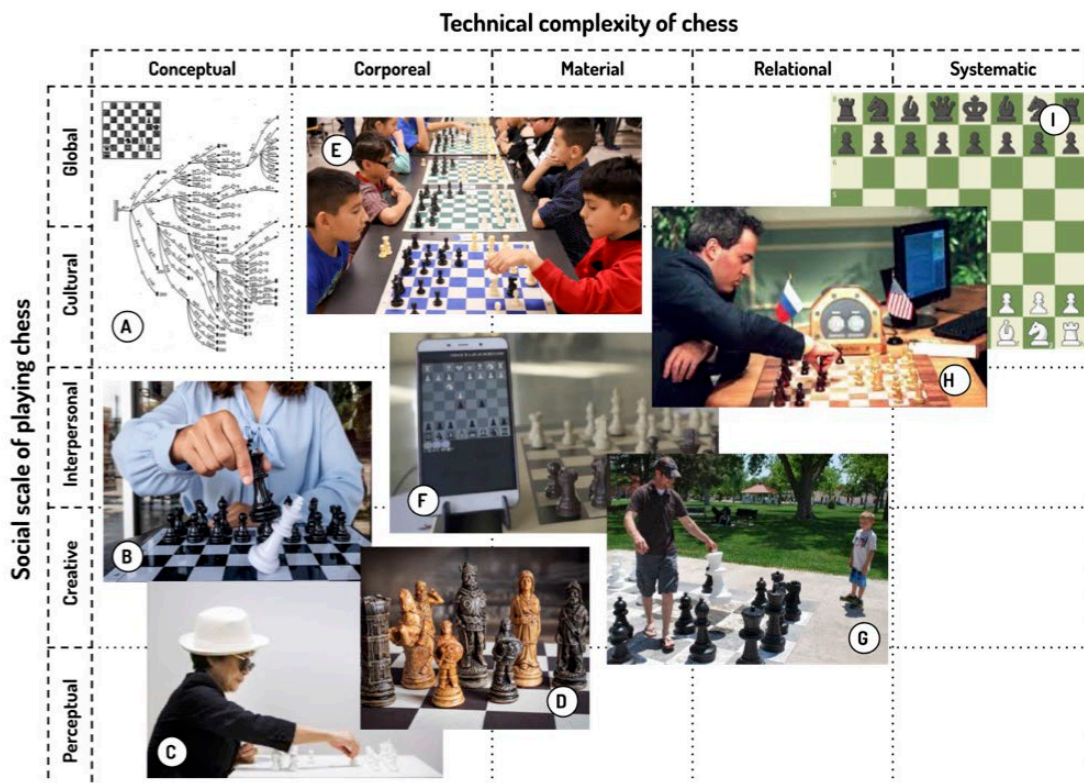
This example shows an empty space on the perceptual-creative and systematic quadrant. An opportunity for innovators: to develop a new system that is not focused on the interaction with other players, but on single players, for example, by sharing tips and teaching new players how to play chess.

Another way to illustrate a practical application of the play~game continuum, arises when we imagine a teacher using any existing game to teach her students about problem solving. The continuity of this field allows her to frame the exercise within the game (by finding problematic situations within the 8x8 bicolor square board with 32 pieces and 6 different movements of chess) or by looking at opportunities to engage new players, for example, by designing a new set inspired by their favorite characters. From a didactical perspective, both exercises may yield solutions that she can't even imagine on her own; for her, the complexity lays not so much on the technical constraints of the games, but on the possibility to cue the right attitudes and timely feedback for the students, so they can find their own answers and translate them into playable scenarios.

3. Discussion

As gaming becomes online, Walter Benjamin's preoccupation on the shifting nature of art, brings the discussion of games' reproduction from the mechanical era to the digital; as the technical replicability of online games appears to vanish, the discussion about each game's 'soul' shall no longer be laid on the artifact itself,

but on the experiences elicited along their life cycle, from development process to actual play and perish. Game designers must therefore maintain healthy and empathic attitudes to undertake dialogical, critical and ethical relationships over lively and democratic atmospheres where everyone is welcomed to intervene by sharing their experiences and contributing to the common evolution of play.

In accordance with Simon Nicholson (1972), a pedagogy of play cannot be complete if it does not ensure equitable access to self-determination, nor if it overlooks the privilege of participating in crafting other players' experiences. In order to spark collective action, to coordinate political deliberation of everyday life, to take into account the difference and complementary, creative dialogue between players and designers has to be acknowledged as an opportunity to enable intrinsic cooperation, as a genuine search to enjoy each other.

While games do limit the span of play, they also expand the detail by which we can create and amplify fictional universes that liberate ourselves from the tediousness of normality, opening further research opportunities to integrate play into conventional spaces, such as education, but also in tax collection and urban planning, suggesting alternative means for acknowledging the world as open playscapes, allowing players to increase the extent of their agency as they learn about their surroundings by trial and error.

From children to adults, the games we play are key to forging our identity and the reasons why we play may be at the core of our own destiny. In the words of the father of logical positivism and the Vienna Circle: "If we wish to find a meaning in [life] we must seek for activities which carry their own purpose and value within them, independently of any extraneous goals; activities, therefore, which are not work, in the philosophical sense of the word. If such activities exist, then in them the seemingly divided is reconciled, means and end, action and consequence are fused into one, we have then found ends-in-themselves which are more than mere end-points of acting and resting-points of existence, and it is these alone that can take over the role of a true content to life." (Schlick, 1927, pag. 114).

4. Conclusions

When seeing games as part of a cultural environment, Salem and Zimmerman (2004) noted that the boundaries between the playscape and everyday life may be blurred; either by designers who want to control the delivery of the story behind their games or by teachers in the search for cognitive adventures, looking to motivate their students to imagine new forms of being.

In contrast with these ideas, contemporary societies have lost their inclination towards play, focusing most attention to deal with the –real or imagined– threat of the status quo. By relegating social creativity to what Von Borries (2019) described as 'survival design', a state of emergency is normalized, justifying exceptional measures that prevent genuine improvements, since most efforts are targeted to avoid the catastrophe by focusing on the necessity, not on the possibilities. As a result anxiety, submission and other social injustices are legitimized.

Given current circumstances of crisis, misinformation and unsustainable industrial development, it becomes important to highlight the need for clearly stating the intentions behind play. From intention, concept, and materialization, to testing and implementation, the aesthetics of play transcend conventional narratives that focus on the tension between the object and its passive perception. On the other hand, games may be the right cue to enable playful interactions, which may be regarded in the terms of Roberto Farnè, as a meaningful long-life education.

Moreover, as we live in overproduced contexts, where material and symbolic richness is unevenly distributed and continuously degrading (as it becomes normalized and fetishized), play may be issued to recycle heirloom metaphors. In the search for more and diverse significant learning experiences, games implement people's

agency as they inspire new narratives to interpret and interact within our everyday lives, transforming our surroundings into better *possible* places.

Acknowledgements

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