Media, Communication
& Socio-cultural Processes

Media, Communication & Socio-cultural Processes

Creative media are contexts, catalysts and cultural technologies, playing a pivotal role in activating and directing contemporary phenomena that take place in our society. Communication processes and Cultural Practices book series meet the perspective of observing the social reality starting from the role of media and of communication's processes. Media, Communication and cultural processes, in fact, aims at being the publishing frame for editorial proposals, academic and with a strong attention to empirical research, that want to investigate contemporary phenomena looking at what happens concretely in our society and that involve individuals: as single person, group or community.

The research areas

Phenomenon, culture and subjectivity are the three main research points on media that guide the selection of the proposals. The starting point of the Communication processes and Cultural Practices book series' perspective is that it is not possible to identify clear and neat borders with in these three social constructs and that the richness of the contributions is represented by the contamination, contact and dialog among them. Moreover, it is the way to guarantee a multidisciplinary glance to contribute the "discover", the proposition of new analysis, enable to contribute to the dialog theories and tools of contiguous disciplines.

I media creativi si presentano come contesti, catalizzatori e tecnologie culturali, svolgendo un ruolo centrale nell'attivazione/direzione dei fenomeni contemporanei che nella società prendono forma. Osservare la realtà sociale a partire dal contributo dei media e della comunicazione è la prospettiva che caratterizza la collana Media, Comunicazione e Processi culturali che intende fare da cornice per le proposte editoriali, di tipo accademico e con una forte attenzione alla ricerca empirica, volte a indagare fenomeni della contemporaneità a partire da ciò che accade nella società e coinvolge direttamente l'individuo: come singolo, come gruppo e come comunità.

Le aree di ricerca

Fenomeno, cultura e soggetto sono i tre punti focali delle ricerche e degli studi sui media che trovano spazio all'interno della collana. Il principio di fondo è che la definizione dei margini di questi costrutti sia impossibile e che nei limen, nel contatto o intreccio, nella relazione tra di essi vi sia la ricchezza prospettica e interpretativa che possa garantire uno sguardo multidisciplinare e favorire la scoperta, la proposizione di analisi nuove, capaci di fare dialogare teorie e strumenti di discipline attigue.

PLAY SERIOUSLY
The Transformative Power of Video Games

Preface by Fabio Viola

edited by Alessandra Micalizzi

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A glimpse into the world of video games

What does the video game represent today? Is it a mere form of digital escapism as often perceived or otherwise a language, a new digital landscape that intertwines and overlaps with traditional physical spaces? Is it a place for socialization where individual and collective identities are formed? If so, can it be a political platform where great themes of modernity are addressed? Ultimately, is the video game the tenth form of art? If true, can we consider its creators as artists?

Regardless of individual perspectives on the matter, it is undeniable that video game industry has crossed both technological and entertainment boundaries in just half a century. Video games increasingly hold a central role in the daily routine and imagination of three billion people annually (Wijman, 2022), including 14.2 million in Italy (IIDEA, 2022). Whether the gaming session takes place on a console, PC or smartphone, the ever-growing process of gamification reaches all aspects of society. From education and employment to social and economic interactions, even those who have never wanted, or been able to, play will be part of this reality.

The chance to comprehend the present comes from video games and the new cultures associated with them, offering a beta test for the society to come. In a digital world where every human action travels along highways made out of *bit*, videogame represent the ripest fruit of post-modernism.

As emphasized by Zimmerman "each of us will become a game designer" (Zimmerman, 2014), implying that everyone will be actively called to participate in the game of life through a knowledge of the mechanics of play. Nobody is born a game de-

signer, but anyone has the potential to become one by gradually establishing an unspoken agreement with the player. This makes it possible for game designers to learn from any mistakes they might make. Nowadays, game designers have taken on the role of experience designers.

Their work holds a certain magical aura, as creating new and captivating experiences is not an exact science. Moreover, individuals may have diverse sensations, even when confronted with the same context. Faced with this hight degree of randomness, videogame creators spent the last 50 years experimenting and refining techniques, acquiring a toolbox for engineering the human soul. This knowledge of audiences and how to stimulate their interaction has increasingly led companies and public bodies to integrate gamification logic (term of the common parlance since 2010) into their processes and products, by hiring game designers, gamification designers and engagement managers (Viola, 2011).

Let's now go back to the1970s in the United States, where video game industry pioneers Nolan Bushnell and Ted Dabney acknowledged the importance of improvement through direct confrontation with their audience. They developed *Computer Space* (Syzygy Engineering, 1971), which was the first commercial video game. In it, the player controls a rocket by using four buttons: forward thrust, firing missiles, clockwise and counterclockwise rotation. With this setup the player can control the fired missiles too. The rocket can move freely on the screen while attempting to destroy two flying saucers that move symmetrically and take turns shooting at the player. Although of historical significance, *Computer Space* has the inconvenience of being very imbalanced, resulting in a frustratingly difficult gameplay experience. The creative duo had the chance to refine their approach due to valuable feedback from players, and published *PONG* (Atari, 1972) the following year.

This simple table tennis simulator allows players to move a white bar along the vertical axis, acting as a paddle that hits the ball and send it back into the opponent's court, competing

against each other or the computer. *PONG* quickly achieved huge success as the first ever arcade game that was both simple and intuitive. The initial unsuccessful project resulted in the formulation of *Bushnell's Law*, which essentially states that the best video game should be easy to learn and difficult to master.

This concept has become a staple in all the design manuals, highlighting the significant difference between a game designer and a technological specialist or the conventional designer. To excel in this profession, the game designer should combine expertise with anthropological and psychological insight. This means that dialogue with the public and a deeper understanding of the human psyche are essential prerequisites. The game designer surpasses user-centred design and instead focuses on user emotions and experiences, known as engagement-centred design.

What if the world was designed to have a progressive learning curve that accommodates everyone's abilities, neither too simple nor too complex? What would it be like to be constantly immersed in a state of flow, completely absorbed in a playful and voluntary act, unconcerned with the passing time and continuously improving our life performance?

These ideas trace back over two millennia, when Herodotus wrote in his *Historiae* the events of the Lydian people in the 7th century BC. A devastating famine took place throughout Lydia during the reign of King Atis, son of Manes. The inhabitants tried to resist it, but it did not cease, so they sought remedies and each of them devised something. It was at this time that dice, knucklebones, balls and all the other games were invented (…). And they did so against the famine: for one whole day out of two they played as not to feel the need for food, while the other day they ate. This way, they lived for eighteen years. Historical accuracy aside, Herodotus introduced the game beyond its entertaining dimension just for the sake of playing. He made it a fundamental social factor for human survival by all means. The same point was reiterated in the mid-twentieth century by the historian Huizinga in his essay *Homo Ludens* (Huizinga, 1951).

One can imagine a world based on the participation of billions of individuals who can consciously play the game of life and actively engage themselves in the experiential dynamics of action, interaction and reaction, similar to what happens during *FIFA*, *Fortnite* or *Candy Crush* sessions.

The fundamental principles of engagement design are action, interaction, and reaction. Movies, books and music often have a linear structure planned in advance, with the audience able to act exclusively outside of the media. Conversely, video games enable players to actively participate in the creative process and shape their own unique experience within the medium. A non-conventional definition of the video game can be "a system in which the player is constantly asked to make decisions".

This is a world of complexity where meaningful choices collide with everyday reality in which we are allowed only to make ornamental decisions. Inevitably, it is up to the game designer to encourage various forms of player engagement within the system, all physical, emotional and cognitive actions. As a result, a transition occurs in the participants. They stop taking part as mere viewers who experience the narration in third person to become instead the protagonist. When the transfer of power is well-balanced and successful, the participant will start speaking in first person, singular or plural: "I saved the princess", "our clan won the challenge", "I broke the speed record on the track".

In addition to action, video games also provide interaction, which is defined as the capacity to foster collaboration, competition and coopetition (competition between groups). New no-space and no-time communities with fluid structures continually arise and dissolve around shared interests. Video game players from different location collaborate or compete in synchronous and asynchronous modes, all striving towards common goals. Bonds and friendships are formed through this process, both in real life and in groups with organised rules and specific roles such as clans and guilds.

Let's consider *League of Legends*, the multiplayer online battle arena (MOBA) developed by Riot Games. The massive mul-

tiplayer online experience around this iconic title opens a window to the new community formation within e-sport. This new form of competitive gaming involves athletes who use controller, keyboard and mouse and may soon be added to Olympic competitions. Not only has "pro player" become one of the most sought-after careers among teenagers around the world, but a multitude of fans enthusiastically support their favourite teams, both at physical events and on dedicated online platforms like Twitch. To grasp the scale of this phenomena, let's only consider that in 2022 the *League of Legends Finals of World Championships* had a peak of concurrent viewers of almost 5.15 million (Gough, 2023).

Thus, it is evident that the responsibilities of game designers extend beyond simply creating video games of varying degrees of success: they must strive to generate communities and identity experiences. The video game has become a significant platform for cultural consumption in today's world, due to its intrinsically collective nature. Worldwide players are constantly encouraged to collaborate and compete with peers resulting in active in-game interaction. As a consequence, the traditional and passive role of the "spectator" substantially shifts towards the "spectActor".

Although the evolution towards spectatorship may seem sufficient to justify the need for a game designer at the centre of future experiences, it is still necessary to anticipate a further step, that of the "spectAUthor". This new and advanced level of involvement allows player to participate in the process of co-creation of the virtual world itself. They can generate maps in *Minecraft*, build infrastructures in *Roblox* or create virtual objects such as NFTs to be shared within the gaming platforms that will form the basis of future metaverses such as The Sandbox. This new type of authorship is emerging, in which authors and spectators will depend on each other to fully express and generate meaning.

Collectivism applies to the production process too, as interdisciplinary teams comprising of designers, musicians, artists, programmers, graphic and game designers work side by side

to bring each video game to life. This is followed by a complex but creative and professionalised market, capable of generating around two hundred billion dollars in direct profit and another hundred billion indirectly (Wijman, 2022). High-budget productions, also known as AAA titles, usually require a multi-million-dollar investment along with approximately two to three hundred people working on a years-long project. It is not unusual for the production process to surpass that of Hollywood blockbusters. Despite the existence of a Game Design Document (GDD), it cannot include the stratification of game design tasks. Creating a video game is a choral experience by necessity: a single game designer would never be able to deliver a complex game experience, just as a game programmer or artist working alone would face similar limitations. The interplay of various disciplines in the production process facilitates the understanding of video games as a meta-form of art. Painting, sculpture, music, poetry, architecture, photography, comics, film and dance all coexist in the same digital medium, which together constitute the tenth art form. Its distinctive feature emerges from the amalgamation of static and moving art: interactivity. In fact, the game designer is responsible for developing an organic system that can react to every player's action by receiving inputs and producing corresponding outputs.

The video game holds artistic and cultural value, as the game designer takes on the role of an authorial figure who generates new contemporary mythologies. There is a lengthy archetypal continuum connecting human narratives, which likely began with the arrival of Homo Sapiens and the oral transmission of stories. Over time, new form emerged thanks to technology. From the Epic of Gilgamesh, the oldest written narrative, through the Iliad and the Odyssey, the Bible and the Divine Comedy, to the more recent Star Wars, Matrix and Harry Potter. As mythological tales become interactive narratives and the ritual functions are transformed into gameplay, video games bring ancient archetypes to the surface. These can be seen in forms such as the myth of the Minotaur's Labyrinth, found in games from *Pac-Man* to

Shadow of the Colossus; the initiation rites in the various chapters of *Zelda*; the eternal struggle between a sovereign and his offspring, mirrored in *Metal Gear Solid*; or the classic of the princess kidnapped by a dragon, as seen in *Super Mario Bros*.

After all, stories and emotions are timeless; what evolves is the setting in which the magic happens. This is a great responsibility for the game designers of the 21st Century, whose work stimulates reflections and reactions in millions of people and become the subject of heated debate in the same way that cinema and television were in the 20th Century. The British journalist and video game critic Keith Stuart shared his observations in the Guardian's article *Game changers: how the increasing cultural significance of video games is reflected in our coverage*:

> We analyse games as an artform rather than a product. Our reviewers are seeking to examine and convey the experience of playing, the feel of the world, the pull of the narrative, the emotional connection with characters, or the intelligence of the mechanics – and crucially how these are achieved – rather than providing a clear guide on whether or not you should buy a consumer item (Stuart, 2017).

His insights are valuable as we move forward in understanding that video games are beginning to be studied and analysed as works of art, rather than as mass consumer products. The focus is now on the sensations triggered by the game experience and the narrative power, the character development and, above all, the emotions that the game can evoke.

Ultimately, real-time feedback is the defining characteristic of the medium and its capacity for perpetual advancement. The video game or game-based system adapts to the participant's needs through constant osmosis, resulting in personalized interaction (one-to-one) and eliminating massification effects (one-to-many). The participant's behaviour affects the difficulty level, and the narrative may also undergo changes based on the spectator's decisions or chosen paths.

The process of personalising an experience, the sense of im-

portance, the constant receipt of stimuli and feedback are shared characteristics, not only of in video games but of all those experiences that are winning the temporal challenge of entire generations, even ahead of the economy. Educational institutions, businesses, workplaces, museums and governmental bodies should consider *Roblox*, *The Last of Us*, *Among Us*, *Netflix* and *Spotify* as models (and competitors) for their ability to reach new audiences, to engage them and to convey complex information. These innovative systems are part of, and sometimes the cause of, an anthropological shift from twentieth-century generations raised on 'having to do' to postmodern generations raised on 'wanting to do'. After all, what are video games if not places of protagonist, personalisation and participation? They represent creative portals through which players are called to make key decisions, determining the narrative's path and, in some cases, to even change the story's outcome. Players engage with the game by using their bodies, skills and emotions, transforming form mere listeners to active participants, which means shifting from the storytelling to the storydoing. In this sense, video games represent the ultimate expression of human free will, requiring constant decision-making process that yields significant consequences.

Video games and quality of life

Recognized the first-person role that video games provide, they can be a highly effective medium for specific fields. While playing the game, our minds absorb the information necessary to solve riddles, level up, become stronger, or at least not be defeated. Hence, we discover that we need the right grip and enough strength to climb a wall successfully (i.e. adventure game – *The Legend of Zelda: Breath of the Wild*); we realise that certain food give us energy, other poison us (i.e. survival game – *DayZ*); we experience that, depending on the answer we choose, we will or will not get the support of a person who may play a strategic role in our personal quest (i.e. RPG – *The Witcher, Baldur's Gate*).

What if each video game player could transfer everything that was learned in-game into real life? Can video games serve as a means of gaining essential information about our daily lives?

Although it is a common belief that video games are only a mere way of seeking isolation or escaping responsibility, especially among adolescents, there is a lack of structured documentation to prove this. Instead, several studies regarding the impact of video games on people's lives are emerging.

In terms of social impact and effects on mental wellbeing, the Entertainment Software Association (ESA), in collaboration with Australian, Canadian, European, and South Korean gaming trade associations, has recently published the *Power of Play* report. It showcases the findings from academic research on the positive impacts of gaming, which were peer-reviewed and corroborated by a survey of 12,847 weekly gamers, aged 16 years and above, across 12 countries: Australia, Brazil, Canada, France, Germany, Italy, Japan, Poland, South Korea, Spain, the United Kingdom, and the United States (ESA, 2023). The presented data reveal that video games provide a platform for creating communities that would otherwise be impossible due to geographical constraints. The majority of players globally assert that they play with other people in physical or online on a weekly basis. Nearly 70% of people report a positive or extremely positive gaming experience when engaging with others. Additionally, over two-thirds of global gamers agree that video games facilitate the formation of new friendships and relationships.

Therefore, video games can support the development of social and emotional skills, implying important psychological advantages. Again, according to the *Power of Play* report, video games offer gamers a range of social and emotional benefits that are shared around the world, for example, more than one half declare that video games helped them to make it through hard moments of their life. While enjoyment remains the primary reason for playing video games, worldwide gamers agreed that playing video games reduces their stress levels (75%), promote their mental well-being and enhance their happiness and seren-

ity (63%). Specifically in the United States, 78% of participants identified decreased anxiety and feelings of isolation/loneliness as additional benefits of playing video games (ESA, 2023).

This report refers to case studies that have already been conducted for some years. One is the 2021 study of the Oxford University which revealed a positive correlation between time spent playing games and people's wellbeing. Over three thousand gamers, aged 18 and above, were involved in the study, playing *Animal Crossing: New Horizons* and *Plant vs Zombies: Battle for Neighborville* (Johannes, Vuorre, & Przybylski, 2021). It tracked the amount of time spent in-game and combined it with a survey of players' mental wellbeing. To cite the publication: "Contrary to many fears that excessive game time will lead to addiction and poor mental health, we found a small positive relation between game play and wellbeing". Players reported feeling better overall due to decreased stress and the absence of negative or aggressive mental patterns. It should be noted that the study was focused solely on two games and did not offer a comprehensive understanding of gaming dynamics. Therefore, this simply is a correlation. However, this study is not unreliable like many previous studies based on self-declaration. According to the Research Coordinator, Andrew Przybylski, conducting a study with scientific methods allows meaningful data to be provided to socio-sanitary institutions. In fact, these types of institutions are gradually moving towards the gamification model, as demonstrated by *the Food and Drug Administration*'s approval of the first video game for curative purposes (FDA, 2020).

In 2020, the FAD achieved a significant accomplishment by granting official authorization for the world's first prescribable video game as a medical treatment for children between the ages of 8 and 12 with Attention-Deficit Hyperactive Disorder, also known as ADHD. After seven years of experimenting, neuroscientists and game designers have found a playful way to target the areas of the brain that are key to attention. As this experience is intended to be used in combination with a treatment plan, doctors are authorised to prescribe a daily half-hour session of the

game *EndeavorXR*, produced by Akili Interactive.

How does the treatment function? After selecting the avatar, the players will pilot a spaceship along specific paths and collect objects. Overcoming the challenge involves avoiding aliens and other elements that fill the screen and try to interfere with the players' concentration. Constant focus must be maintained if they wish to achieve the objectives! While concentration training is an obvious result, how does this game differ from many similar games available at home or on mobile platforms? If a test were to be carried out on Crash Bandicoot's player, would we discover the same effectiveness?

While waiting for the research to discover Crash's effect, it remains significant that gamification is being combined with medicine as a tool to create new forms of care and support. *EndeavorXR* deserves the credit for demonstrating the diverse roles that videogames can fulfil, so that they are no longer underestimated.

The role of Serious Games

Video games have demonstrated and continue to demonstrate the ability to exceed their primary function of entertainment. It is no coincidental that *Serious Games*, i.e. video games that aim to achieve a number of goals beyond pure entertainment, are rising in popularity. The chapter *Origins of Serious Games* in the book *Serious Games and Edutainment Applications* (Djaouti, Alvarez, Jessel, & Rampnoux, 2011), explains the genesis of what appears to be an oxymoron. It cites the linguist Huizinga and its definition of game such as "a free activity standing quite consciously outside 'ordinary' life as being 'not serious', but at the same time absorbing the player intensely and utterly" (Huizinga, 1951). Then it moves to almost twenty years later, when the American researcher Clark C. Abt published the book *Serious Games*. Abt worked in US laboratory during the Cold War and used games for training and education: he designed multiple computer game that were used by military officers to examine the conflict on a worldwide

scale. In his book he states that "Games may be played seriously or casually. We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining" (Abt, 1970). "Learning by doing" was the key idea in which playful aspects are combined with a serious content, so as to make an effective training. Nowadays, serious games have widely proven to be a valuable tool in education (Kirriemuir, Krotoski, Ellis, McFarlane, & Heppell, 2006), defence, healthcare (Lieberman, 2001) and many other fields. The primary goal remains education and training, while several other objectives can be established depending on the field.

Serious Games and Healthcare

- Eating proper food, engaging in physical activity and adhering to medical prescriptions regularly are amongst the most highly recommended practises for individuals seeking to maintain a healthy lifestyle. Nonetheless, it can be challenging to establish these practises as concrete habits. Here are the main focuses on healthcare field, with some examples:
- *Education and training*: doctors can practise in virtual reality through simulations (Samadbeik, et al., 2018), children can learn how to manage their condition or spread diseases' awareness; *Captain Novolin, Tako Dojo* (D'Aprile & Severino, 2016), *Fragments of life* (Fragments of Life: A success in the frontier of medicine becomes a video game, 2020);
- *Encouraging physical activity*: people of all age can walk, dance and workout while having fun (Wang & Skjervold, 2021); *Pokémon Go*, *Zombies, Run!*, *Just Dance*, *Wii Fit*, and *Ring Fit Adventure*;
- *Foster social interactions*: since major illnesses are often related with social isolation, multiplayer and cooperative

games are an additional way to promote social interaction; *Minecraft, Roblox;*

- *Supporting scientific research*: everybody can contribute to research just by solving specific puzzles. *Foldit, Sea Hero Quest*.

However, gamification's potential extends far beyond these points. The true value lies in its ability to engage patients in their healthcare. By usings the action-interaction-reaction mechanics previously mentioned, games can create engagement through cycles of actions designed to produce a defined effect in the subject, for example, an emotion or a positive feeling, which encourages him/her to repeat the cycle several times, eventually until they are established as habits and become natural gestures. This system is called the *engagement loop*.

By well-calibrated timing and rewarding, video games industry has demonstrated to be able to effectively engineer this loop. Who would have thought that being a waiter, a farmer and an air-traffic controller were successful ingredients for a video game? Nonetheless, games like *Farmville*, *Air Traffic Control*, and *Diner Dash* have all been global bestsellers, motivating millions of people to engage in tasks they would typically avoid in reality, even if paid. Instead, those individuals have spent hundreds of hours of their life carrying out tasks within a virtual world. The key lies in the cyclical nature of the engagement: actions are repeated countless times in a pattern that constantly adds rewards and a bit of unpredictability. By consistently providing support, the initial interest can turn into a lasting engagement.

What engagement loop makes possible is to put in place tool to a) create involvement in otherwise tedious, unappealing or indifferent tasks; b) maintain engagement where it might be waning, making it easier to sustain; c) when appropriate, find ways to conclude the engaging experience, so that it no longer fully absorb the person's attention and energy, allowing to be redirected to other goals and purposes (Viola & Idone Cassone, 2017).

These are some of the reasons why gamification is seen as a potential method to motivate individuals to engage in health

management and improve the level of their health management performance (Yang & Li, 2021).

Video games and Research Development

Solving *Professor Layton*'s riddles or beating the most challenging *Candy Crush* levels provides an amazing sense of satisfaction. "I did it!" or "Eureka!" one may exclaim upon coming up with a great solution to a tricky puzzle or level. Problem solving is a key strategy for overcoming obstacles in numerous jobs, including scientific research, which is undoubtedly one of the most challenging. The two following cases will display that video games can offer support in this area too.

Firstly, *Foldit*, a one-of-a kind protein folding computer game developed by university scientists. Players contribute to advanced human health and bioengineering research by solving protein folding puzzles. By participating in weekly challenges, players can suggest ways to solve puzzles created by researchers dealing with real-life situations. Foldit is helping to advance research to combat diseases such as HIV/AIDS, cancer and Alzheimer's, invent new drugs or classify biological molecules. The game is provided for free and is not-for-profit, with peer-reviewed journals crediting players for their discoveries. As an example, here are two publications which were made feasible thanks to this game: *Foldit Standalone: a video game-derived protein structure manipulation interface using Rosetta* (Kleffner, et al., 2017) and *Crystal structure of a monomeric retroviral protease solved by protein folding game players* (Khatib, et al., 2011).

Secondly, *Sea Hero Quest* is a pioneering virtual reality game designed to accelerate dementia research. The project was initiated by Deutsche Telekom, GLITCHERS, UCL, UEA and Alzheimer's Research UK with the purpose of allowing scientists to collect valuable data on the age-relate changes in spatial navigation skills typical of the early stages of Alzheimer's disease. Played by 4.3 million people worldwide, the game has expedit-

ed years of research. Gathering data from people of all ages and backgrounds a benchmark is being created, and it helps diagnose the disease from its most early signs. The game's plot revolves around a sea adventure undertaken by a son attempting to regain his father's memories, which he has lost due to dementia. The game includes three parts: navigation, rocket firing (to check orientation) and creature hunting. Each section has been meticulously designed to provide both entertainment and scientific accuracy. The game was nominated at the 2018 British Academy Games Awards in the 'Game Beyond Entertainment' category.

Conclusion

Playing seriously is not a contradiction in terms; it is the choice of using a powerful tool to make an impact on everyone's life. It is the decision to turn challenging tasks into puzzles, complicated mathematical calculations into riddles and the management of health therapy into a game with prizes. The video game's mechanics can address even the most arduous situations; despite not necessarily providing a solution, it can still make a difference in the quality of life bringing enjoyment, sense of community and awareness.

With these premises, it is reasonable to imagine in a near future a welding between the wellbeing/ welfare sector and the video game industry.

The figure of the game designer has proven to be central to the processes of engagement and active stimulation to participation, fundamental requirements in the new health care models in which prevention and adherence to medical protocols becomes a necessary condition for the well-being of a progressively aging population. We will witness the emergence of increasingly trans-disciplinary teams where clinicians, researchers, psychologists, game designers, artists, and programmers work together toward the creation of digital medicines. As already demonstrated by the U.S. case study of Endeavor Rx, exciting experiments

are underway to move beyond the chemical-based drug alone.

The purpose of digital therapeutics (DTx) is to intervene directly, on a par with traditional pharmacological interventions, in the therapeutic or preventive setting of a not inconsiderable number of pathological situations of various kinds. These therapeutic tools may consist of devices that the patient can wear, or applications, websites or even more video games.

Insider Intelligence estimates the value of this fledgling market at around $56 billion in 2025 thanks to the broadening spectrum of digitally attackable diseases such as depression, chronic insomnia, hyperactivity, several kinds of addictions, symptoms associated with chemotherapies, irritable bowel syndrome, autism spectrum disorders and high blood pressure.

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Play Seriously
A collective experience from the academy to the fieldwork

by Alessandra Micalizzi

> "Playing is a dance between creation and destruction, between creativity and nihilism" (Miguel Sicart, 2014, p. 3).

Just few words to introduce our experience

Over the course of several decades, studies and research in the field of developmental psychology have confirmed the importance of play during childhood, –and since the beginning of the interaction with the external world – for the acquisition of motricity, language, psychological and relational skills (among others Huizinga, 1955; Winnicott, 1984). However, for adults – and in the common sense – "playing" maintains a connotation strictly linked with leisure, spare time and vacation of specific purposes. Probably for this reason, even if a video game simply transposes the same dynamics and logic within a digital context, video games have not enjoyed social legitimacy. On the contrary, they are frequently associated with negative imaginary such as antisocial behaviour and addiction (Madigan, 2018).

Without denying the risks associated with improper use, several studies have demonstrated the advantages of video game play on users' motor and cognitive development, the points in common between games and video games, as well as their interwoven nature. At the same time, the digital context highlights features that add other (positive) characteristics to the ludic experience. Among them, for example, we can consider the opportunity to play with people that are geographically distant, the effect of immersion in a new reality thanks to the integration of technological devices and so on (among others, Triberti, Ar-

genton, 2013). Indeed, in video games, the imaginary can take a more realistic shape, which contributes to the gamer's psychological implication and involvement: the complexity of the plot is greater. Video games also tend to be addressed to older targets – or at least are generally used by a wider range of publics, of different ages.

It is precisely because of this failure to recognize the video game as an empowering tool and a relational context – like any other type of traditional game – that the label "applied game" or "serious game" has been introduced in game studies, even if creates controversy. Introducing a new label legitimates the distinction of the production of games with explicit educational purposes, apart from the "classic" video games, which are mainly recognized as having an entertainment aim (Schmidt, Emmerich, Schmidt, 2015).

Play Seriously, the project described in this book, starts from the assumption that play can be an interesting environment in which to create and cultivate relationships; where users can learn new things, work on self-empowerment and ultimately test their own skills. In other words, video games can offer a safe space where several things can happen, thanks to the level of agency of the players. The project was pushed further by the consideration shared by therapists and other figures who work with the rehabilitation and support of patients during the lockdown: the pandemic period introduced severe restrictions in managing interpersonal relation, hampering the work in presence of health practitioners. It was thus hard to carry on with all of the forms of therapy, support, screening and diagnosis based on the direct patient-specialist relationship, which shed light on the urgency of adapting techniques to virtual contexts.

If the pandemic can be considered a conjunctural situation, the impact that it generated could produce more lasting effects, especially with specific types of users. If we consider the specific cases of diagnosis, screening and rehabilitation with young patients – and above all children – it is sometimes difficult to create the right setting without building barriers in the relation

between specialists and patient. The stadium is perceived as a "clinical" context, where there are deceased. This perception, combined with the specific situation of "testing", can trigger performance anxiety, which can lead to bias and mistakes in the assessments. To sum up, there are two premises for our research and development project:

- playing is one of the possible resources that individuals can use to improve skills, to develop the self and, in short, to grow up;
- video games, which are based in digital contexts, can be privileged places where patient–specialist relationships can take place, thanks to their specific characteristics, which contain the emotional impacts, ensure remote management and create a safe environment for patients (with a special consideration for the youngest patients).

Digital games could thus be an alternative meeting point for both screening and self-empowerment, as well as for monitoring the development of skills in young patients (Thompson, Foldnes, Uppstad, 2020). "Play Seriously" is the name of a project promoted by the SAE Institute, co-funded Central European Initiative Funds (CEI) and supported by another five institutions throughout South-West Europe: the University of Banja Luka, SAE Institute Belgrade, University of Montenegro, Babes Bolyai University of Romania and SZTE Institute of Budapest. The project sought to verify the previous assumptions supporting the development of a digital game suitable for monitoring some of the predictors of dyslexia.

The discussion of the project brief and its development took place during a hackathon (Fig. 1): the game represented a hybrid – allowing online and in presence participation – which brings together two typical ingredients of the game: creativity and challenge. In the following pages, we present a general overview of the project and highlight what we learnt from it, as well as the next steps. We close this first introductory chapter with a quick description of the publication, which represents one of the project outcomes.

Fig. 1. Image to advertise the event

PlaySeriously: more than a creative challenge

What was the core of the challenge? The hackathon sought to achieve an ambitious goal: developing a video game that could identify and possibly monitor certain predictors of dyslexia in the pre-school phase. The event was the final part of a project begun the year before, which involved students in the third year of a course in game design and game art: the idea was to create a small group of motivated students that could start thinking about the main concept of the game, as well as its main passages, to "translate" a screening test into an engaging video game.

From this first step, we obtained a concept, thanks to a first testing with target children. However, we realized that our skills could cover only the technical and creative issues, not the clinical ones. For this reason, the first challenge of the hackathon was to imagine mixed groups of participants from different backgrounds that could share different skills. The initiative opened the participation to game designers and game artists, as well as to psychologists, pedagogues, educators and other figures directly involved in training, screening and directly working with DSA

children. The teams were provided with a brief that specified the concept and the type of skills to be tested, which was paired with some examples taken from standardized tests and indications on the delivery materials.

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Goals

This project intends to investigate and lay the foundations for the development of a digital game that can allow the monitoring of predictors of specific disorders related to dyslexia and to offer a tool that can:

- **screen**: without an invasive approach, the gameplay could help to highlight early-stage signs of dyslexia.
- **monitor** over time: by repeating their gameplay sessions, children can be observed in as they grow.
- **Enhance** some skills: the applied game could be a remote tool eo empower specific skills thanks to repetition.

Moreover, the game would aim to:

- reduce performance anxiety (which often affects evaluation results); and
- promote social inclusion (between children with and without specific disorders) by offering a common (virtual) playful place.

Concept

Over the last two years, SAE Institute Milano has already tested, with a non-representative sample of 20 preschool children, two narrative concepts, identify the following opening plot:

We often get lost with our nose up, imagining that we can jump from one star to another, to discover new worlds and to experience many adventures. Sometimes it can happen! If you get on a very special space shuttle, you will be able to explore new galaxies. But beware! The further away they are, the harder it will be to get home. Have a good trip!

We asked each team to develop their proposal starting from this concept. The team was allowed to change the formulation of the text but must respect the main idea. In other words, the game should take place in a space environment.

Mark! The game should be inclusive!

Any allusions to gender, race, religion or politics positions are forbidden.

— — — — — — — — — — — — — —

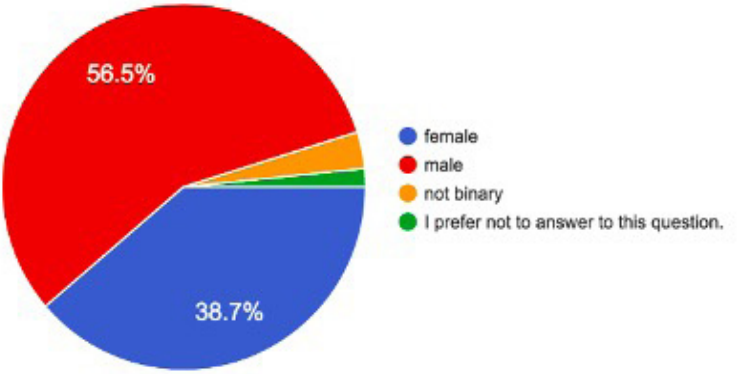
The concept, as specified above, was the result of a preliminary study based on a sample of 20 children between the ages of 5 and 7, who were asked to evaluate the graphic development of some characters and two possible narrative starting points: in the first case, the setting was the forest, in the second space. With a difference of just 8 percentage points, the story set in space was more appreciated. From a purely creative point of view, the two environments guaranteed:

- open and replicable development for a potentially infinite number of "frameworks";
- the construction of different game plans, independent of each other, and therefore closed from the point of view of viable actions; and
- the proposition of inclusive plots, because they were set in fantasy world and free from cultural, gender or ethnicity specifications. Inclusion, in fact, was considered a determining element for the approval of the narrative plot.

More than a hundred participants registered for the event: some of them individually, some of others directly organized as a team. There was a larger percentage of Italian competitors, although a smaller representation of the other five countries (Serbia, Montenegro, Bosnia and Herzegovina, Romania and Hungary) was ensured; but even more interesting was the participation of figures from the United Kingdom, Greece and the Czech Republic.

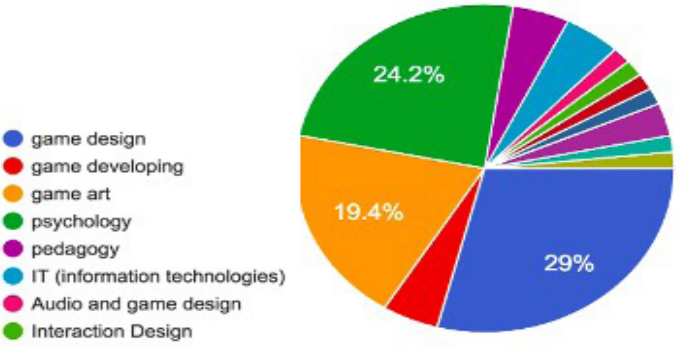
We tried to profile participants thanks to a final computer-assisted web interview, and we collected additional information. As shown in Figure 2, the participants were almost perfectly distributed according to gender: the hackathon confirmed a gender balance among students and practitioners who imagined their professional future in the game industry – even if in different positions.

Fig. 2. Division of participants by gender



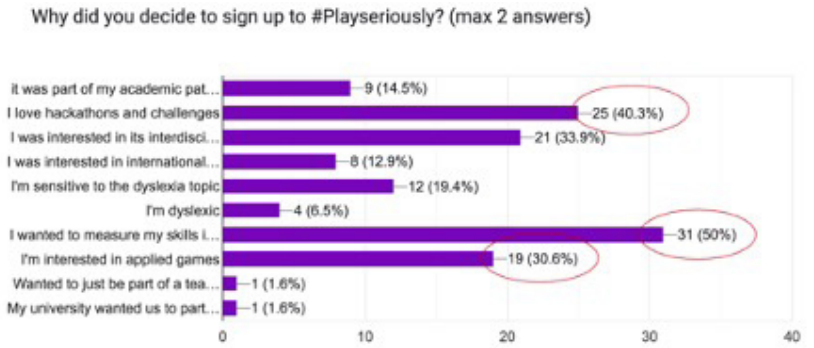
If we look at the formative background of the participants (Fig. 3), we can see that the hackathon had more appeal among game designers, psychologists and game artists, which represent, in our opinion, the pivotal disciplines for the specific goal of the challenge.

Fig. 3. Formative background



As a further notable characteristic of our participants, we shed the light on the fact that the main motivation for participating in this project was the love of a challenge and creativity that, as outlined in a previous chapter, are the main points in common between games and hackathons.

Fig. 4. Synthesis of the main reasons for participating



As specified above, the brief included some examples of validated tests for the screening of dyslexia in this specific age range. More specifically, thanks to Hogrefe, an external partner, the tests proposed for the development of this first concept are those related to predictors of dyslexia in six areas:

- recognition of semantic coherence between represented objects;
- recognition of signs and simple geometric representations that are identical to each other;
- recognition of the graphic sign attributed to a letter (independent of the ability to name it);
- recognition of the initial sound of different words;
- reconstruction of the logical sequence of a figurative story; and
- discrimination in listening to words and non-words with the same phonological construction.

Teams were instructed to incorporate at least two of the six in-

dicated tests from the proposed examples into their game framework, which allowed a margin for narrative adaptation of the required task. The challenge, which took place in presence at the SAE campus and on Discord for participants from other countries, was organized in three stages.

- In the first stage, one week before the challenge, participants received the complete brief with an introduction, a description of the brief and the main instructions. The main goal was to familiarize the teams with the request of the challenge.
- In the second stage, a one-day hackathon took place online and in campus. During the hackathon, participants could discuss their idea with their team and with the tutors, the members of the jury and experts from different backgrounds (game studies, game practices and developing, psychology and education) who were available to answer to their questions.
- Finally, in the third stage, each team had one more week to develop the project autonomously before the final digital delivery on Discord.

Seventeen teams of twenty uploaded a final proposal, and among them, the jury awarded the three best projects an economic prize; the opportunity to attend courses on game development offered by SAE Institute of Serbia and Amsterdam; and the opportunity to show their project during the prize ceremony and at Arcade Hotel in Amsterdam.

What we can bring with us thanks to #PlaySeriously

At this stage, we are working on testing one of the three proposals that we consider as the most adherent to the main goals of the brief, which will be illustrated in this book. The idea is to participate in national and international calls that could support the complete development of the video game. However, regardless these operative steps, the hackathon experience highlighted some interesting aspects concerning the role of play in our cul-

ture.

We used a creative challenge to produce a game that is, in fact, nothing more than a way to test oneself creatively, as well as safely. In this way, we worked on the development of the video game using the same language and the same frame: the main goal was to prove the advantages of this choice. It could thus be called a meta-experience, because we established the rules, teams and final goals of our challenge, using Discord as a playground as well as a touch point among several disciplines, even ones – such as neuropsychology – that seem to be far from game languages.

Playing has been revealed as an excellent virtual space – the so-called magic circle (Huizinga, 1972) – for sharing ideas, creating relationships and testing professional and creative skills. Moreover, our experience confirmed that, to achieve ambitious goals, to create something new and to meet future challenges, we need a multi-disciplinary approach: we cannot remain in the limited world of our competences, but we need the courage to let our views be contaminated by other perspectives coming from different fields of studies. If we remain anchored to our little certainty, we will risk proceeding on parallel tracks that never meet and taking longer to reach the same result.

The choice of a playful frame made it possible to establish tight deadlines, specific rules and to engage many junior figures: they have perhaps less experience – and consequently less competence in developing a complex project – but instead they are totally immersed in the video game logic that was required by the brief. This immersion was necessary for navigating within the complex framework of screening for pre-school dyslexia.

The choice of a hybrid mode allowed the involvement of students and professionals from different parts of Europe: the aim of CEI funds is to foster the exchange of knowledge and its circulation across borders. #PlaySeriously fully respected this mission and showed its richness. At the same time, it confirmed that multidisciplinary and multiculturalism are two perspectives that match well together in digital games, due to its structural and

environmental characteristics. Indeed, the game proved to be not only a valid space for relationships but also the best place – even if virtual – for meeting other people and working in mixed teams, overcoming language barriers thanks to a professional slang that is cross-cultural and strictly linked with the wider game world, based on universal psycho-socio-anthropological roots.

As specified above, more than 100 participants registered to our hackathon, which exceeded our expectations, especially if we consider the short notice of the promotion and the focus on that peculiar type of game, the applied one. This leads to a final consideration: in the micro/macro world of video games made by professionals, as well as by enthusiasts, there is a growing desire for redemption and emancipation from negative common imagery. This view considers gaming purely as an opportunity for entertainment and overlooks the potential of electronic games as a (fun) way to improve educational, relational and psychological skills (among others, Triberti, Argenton, 2013).

Unfortunately, in Italy, this imaginary has been strongly eradicated, and it is common among the public opinion, even if it is possible to perceive some new trends. Today, gamification (Viola, Cassone, 2018) as well as other strategies based on a playful approach, suggest that things are going to change. To be down on earth, the spread of gaming in other sectors – such as education, museums and training – sometimes appears to be more of a formal juxtaposition, dictated by seasonal trends, and less as the result of a true appropriation of ludic philosophy. The consequence is a generalized increase in the interest in games, because the new trend is to fill in the word "game" everywhere.

However, when applied seriously, projects that fully and consciously integrate the game into culture, education and training are successful and confirm the richness and power of this virtual socio-cultural context. Video games are relatively new, if we consider their digital nature; however, they are strictly linked with the psycho-social evolution of humanity since the beginning of the history of human kind. Playing is a natural and genetically driven activity, and we cannot help but use it to grow up and

improve ourselves. Video games simply offer a different frame – the digital one. To conclude this short introductory chapter, we can say that our experience with #PlaySeriously confirms that play can be applied in any context and for any goal, including screening activities, especially when working with children, who are masters in playing strategies and moving themselves naturally in (video) game worlds.

What you can expect from this book

Not to leave the experience of #PlaySeriously hackathon at a draw, we decided to work on a publication to share the main evidence and perspectives on the world of applied games, using the strength of this project – its interdisciplinarity. This book is divided into six chapters, each of which will propose a different perspective on applied games, maintaining #PlaySeriously – as concrete experience – in the background. All of the authors were directly involved in the hackathon and participated actively in several stages of the project. This contributes to enhancing the international value of the publication, because each country involved could offer a different level of familiarity with the tools, such as applied games, and with the format of the hackathon.

We open the book with the contribution of Marija Lelicanin, which provides a valuable frame for the literature about applied games from a semiotic approach. We are perfectly aware of how the debate about the label we use to identify such games is currently open and cannot be considered definitive. The socio-semiotic perspective offers an interesting point of view by considering serious games historically linked to the neo-Platonic concept of *serio ludere*. This is the frame in which Lelicanin highlights the various semiotic elements within these games, such as their representational, interpersonal and textual domains, which include visual signs, linguistic cues, cohesion and coherence, among other aspects. The original element of this contribution is its introduction of a new method that integrates insights from

communication studies, systemic-functional linguistics and social semiotics.

The second chapter, written by Giuseppe Virgilio, takes a step forward in the psychological frame, with a specific focus on clinical intervention. Thanks to his long experience in using commercial games in analysis, Virgilio offers an interesting recap of practical examples and applications of so-called therapeutic gaming. Finally, he discusses in depth the different steps by which the patients are driven inside the game experience, which becomes a therapeutic one as well.

Alessandra Micalizzi is the author of the third chapter in which a psycho-social educative perspective is offered. Her chapter examines the weak and strong points of the use of games as socio-educative spaces, especially when the aims of the interventions are to learn, to screen or to improve skills. After a quick analysis of the main literature on the topic, dyslexia will be presented for the first, not so much as a learning disorder, but in terms of the characteristics that can match the use of applied games in screening and empowerment interventions. Finally, as a part of the specific case of video games, the chapter introduces a general reflection about the application of new technologies in psycho-social projects to support children, teenagers and young adults with a dyslexia diagnosis. This focus on games and dyslexia is functional for introducing the specific cases of the games proposed in the hackathon.

The fourth chapter, written by Sara Zaccaria, travels deep into the psychological and clinical aspects of dyslexia, with a specific focus on the tools used for early screening in the age range of first infancy before the beginning of the school years. Her experience in the international publishing house, Hogrefe, has led Zaccaria to propose a complex point of view that enriched the direct work in the construction and validation of several screening tools.

In the fifth chapter, Sonja Stančić and Arijana Radić tackle the difficulties associated with merging various approaches in higher education systems, particularly in the Republic of Srpska and Bosnia and Herzegovina, with a focus on the social sciences. By

embracing a collaborative and multidisciplinary strategy, they sought to effectively address intricate problems concerning the identification and early management of developmental issues in children. Employing a hackathon technique, the research team created a game for children aged 5 to 7 years, incorporating features that facilitated the recognition and diagnosis of specific learning disabilities (SLD). The hackathon formed a part of the #PlaySeriously Hackathon project, which received support from the CEI Initiative's International Project and involved the participation of students from the University of Banja Luka. This interdisciplinary approach not only tackled the deficiencies in the social sciences but also encouraged the amalgamation of theory and practice and nurtured collaborative efforts, problem-solving abilities and innovation skills among the students. It also fostered a connection between the social sciences and the IT sector, which led to invaluable insights and exemplary practices for educators and policymakers striving to bridge the gap between these fields.

In the final chapter, Laura Mancuso, Chiara Tancredi, Marika Provola, Luca Marino, Eleonora Coppola and Roberta Presta present one of the winning projects from the hackathon and frame their experience inside their individual disciplines, including user experience design, game design and neuroscience, among others. The main character of the game is Fluffy, a space kitten who embarks on various adventures in space and accompanies the child in training their skills – that is, the game is not solely focused on predicting dyslexia. This chapter presents the basics of designing the game and provides a detailed description of how the screening exercises were transformed into a game, while also discussing future perspectives in design, research and user testing.

We invite the reader to follow our proposed track in the index or to jump from one chapter to another guided by personal interests. Finally, we encourage the reader to continue the experience started with the hackathon, because playing with video games is very serious – and can have beneficial effects.

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Play seriously: a social semiotic approach

by M. Lelicanin

> *"Social semiotics is a form of inquiry. It does not offer ready-made answers. It offers ideas for formulating questions and ways of searching for answers."*
> (van Leeuwen, 2005, p. 2)

Introduction

This paper delves into the application of social semiotic principles in the analysis of serious video games. It seeks to expand the boundaries of previous studies, reconciling the previous results into a unique methodological framework firmly based on the concepts of interactivity, communication and other domains of linguistics. It actually aims to facilitate the integration of video games, recognised as a multi-semiotic phenomena, into the realm of social semiotics.

It is grounded in the philosophical notion of *serio ludere*, which is redefined here as a methodical examination of what initially appear to be light-hearted and seemingly superficial examples. In this context, we present the hypothesis that serious games represent a modern continuation of this concept. Another starting hypothesis is that video games might represent a form of a specific communicative process, somewhat akin to those found in the classroom, initiated by a teacher but subsequently proceeding in a more playful direction, relying on a myriad of meaning-making resources. The potential of these meaning-making resources, or, more precisely, semiotic resources, has been acknowledged in the social semiotics. Therefore, the primary objective of this study is to assess the methodological capacity of social semiotics in uncovering and comprehending the meaningful resources

embedded in serious games. Serious video games are perceived as contemporary signifying practices, each containing various resources that collectively contribute to the creation of meaning.

This paper is structured into four segments that collectively approach the potential application of social semiotic principles in the serious video games analysis. In the first segment the concept of serious game will be introduced, focusing on their educational and communicative roles. The second segment looks at the serious video games as a communicative process, highlighting their interactive nature and narrative elements. The third part reviews existing social semiotic research on video games, providing a foundation for our analytical approach. In the fourth section, we present our analytical model, motivated by the need to understand video games more profoundly, offering new methodological tools for their analysis. This section outlines the model's components and demonstrates its practical application in dissecting and interpreting the complex interactions and messages embedded in serious video games, contributing to a deeper understanding of these digital environments within the context of media and communication studies.

Serious video games: a playful communication with serious intentions

The video games are often categorized based on their primary functions and purposes. Games can be categorised also according to different genre (action games, adventure games (solving logical puzzles to progress through a virtual world), fighting games, puzzle games (such as Tetris), role-playing games, simulations, sports games and strategy games) (Kirriemuir & McFarlane 2004; Hertz, 1994) and technologies used (video console, PC, online game, second life, mobile or alternate reality game (Connoly et al, 2012: 664). Connoly et al. (2012) also classify video games into three main categories: games for entertainment, games for learning (with the aims of games-based learning), and serious

games. Games for Entertainment, as a category, includes the vast majority of video games created primarily for entertainment and enjoyment. These games are designed for players to have fun, relax, and engage in immersive experiences. Entertainment-focused games can span various genres, from action and adventure to sports and simulation. Games for Learning (Games-Based Learning) are explicitly designed to facilitate learning experiences. They leverage game mechanics and interactivity to engage players in educational content or skills development. Games for learning can be used in formal education settings, such as schools, or for self-directed learning. They often incorporate elements like quizzes, puzzles, simulations, and interactive storytelling to convey educational concepts or skills.

Although the terms games for learning and serious games may be used interchangeably and as synonyms (Corti, 2006), the latter imply "training and behaviour change" in many fields, from business and marketing to healthcare and personal emotional and cognitive development. "Serious games also have other names, including immersive learning simulations, digital game-based learning, gaming simulations, and "games you have to play," to name a few" (Derryberry, 2007). However, while the term "serious game" is becoming more and more popular (Wattanasoontorn et al. 2013), there is still no unique definition of the term (Wattanasoontorn et al 2013). Anyway, as mentioned, in most cases it is used for games where the entertaining is accompanied with educational, training purposes, as well as those aimed to change some unwanted behavior (Stokes, 2005). Serious games, therefore, become an entertaining activity with educational purposes and/or with the learning outcomes easily applicable in the real-life and working environments (Michael & Chen, 2005; Zyda, 2005). Serious games encompass a broader spectrum of applications beyond traditional entertainment. Therefore, unlike games solely designed for amusement, serious games are created with a carefully thought-out educational or practical objective in mind.

The term "serious games" is an oxymoron introduced much

before the rise of video games. The "*Serio ludere*", to play seriously, was a very popular concept among the Renaissance neoplatonists. It was used to define a specific lighthearted humour in describing some serious events (Manning, 2004). Anyway, with a meaning closer to the one discussed above, related to the gaming field, the oxymoron "serious game" appears in 1970 in a book written by Clark Abt (1970), U.S. researcher from a period of cold war and game developer and designer of games. With the following words Abt defined the serious games and paved the way of the field and future research:

> Games may be played seriously or casually. We are concerned with serious games in the sense that these games have an explicit, carefully thought-out educational purpose and are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining. (Abt in Djaouti et al, 2011).

To sum up, Abt defined serious games as games with an explicit educational purpose, emphasizing that while they have educational goals, they can and should still be entertaining. In recent years, research has increasingly demonstrated the usefulness of video games in various domains:

- Education: Video games have proven effective in enhancing learning experiences, improving problem-solving skills, and boosting engagement in educational settings (Shaffer & Gee, 2006).
- Defense: Serious games have been used for military training and simulations, helping train soldiers and strategists in complex scenarios (Smith, 2009).
- Healthcare: Serious games have been applied in healthcare for patient education, rehabilitation, and behavior change interventions (Lieberman, 2001).

However, sometimes even the distinction between these categories can be very blurred. One notable example that illustrates this phenomenon is the game "Gran Turismo" which belongs to the genre of racing simulation video games. It is renowned for

its realistic portrayal of the world of motorsport. For its realism, simulation and training potential, the game is recently depicted in the movie based on the true story and events where it is documented how an initially adventurous game designed for home play on commercial consoles may have a training potential with real-life applications and consequences. Furthermore, it exemplifies how a video game designed primarily for entertainment can have a significant impact on real-life training and career opportunities, especially in motorsport. The blurring of distinctions between gaming and training is not limited to this title alone, as other serious games and simulators similarly bridge the gap between entertainment and practical skill development. This phenomenon underscores the transformative potential of video games in various fields, from education to professional development, where the line between play and learning can often be blurred.

Furthermore, besides different domains, the serious games might be developed with specific aims and benefits for specific populations, especially those with any kind of disabilities, that might have an impact on learning and educational progress. Following this direction, recent studies (e.g. Franceschini et al. 2013; 2015; Gaggi et al, 2017) have shown that video games can significantly improve the reading abilities of children with dyslexia, "a neurodevelopmental disorder identified in about 10% of the school-age children; affected children show difficulties in reading acquisition, despite normal intelligence and adequate access to conventional instruction"(Gabrieli 2009 in Gaggi et al, 2017).

In summary, video games have evolved beyond pure entertainment, encompassing a spectrum of applications, from education and training to behavior modification. Serious games, in particular, represent a category of games designed with a specific educational or practical purpose while still offering an engaging and entertaining experience. The potential of video games in various domains continues to be explored and expanded through ongoing research and development efforts. As it will become

evident in the following lines and chapters, the research may be done from many perspectives and with different aims. In this paper, we would like to stress the potential of several linguistic disciplines: communication studies, systemic functional linguistics and social semiotics.

In essence, video games, more than any other form of signifying practice in contemporary culture, for instance, a movie or a song, where the main form of communication is still *one to many*, can be linked to a simple conversation. In a typical conversation, individuals engage in a dynamic exchange where one person speaks, and the other responds. This turn-taking structure is a fundamental aspect of communication (Sacks et al., 1978).

> Turn taking is used for the ordering of moves in games, for allocating political office, for regulating traffic at intersections, for the servicing of customers at business establishments, and for talking in interviews, meetings, debates, ceremonies, conversations. (Sacks et al. , 1978)

Similarly, in video games, the player takes actions within the game world, and the game itself responds to those actions. This interactive back-and-forth process between the player and the game closely mirrors the conversational exchange, albeit in a virtual and dynamic context (Gee, 2014). The video game, as said, may be looked at as a specific form of communication where the players immerse themselves in video games, they enter a different reality, the game world. This immersion is more than just passive entertainment; it triggers a complex cognitive process. Players are constantly "modding" the game, which means they are actively modifying and shaping their in-game experiences. They make decisions, solve puzzles, strategize, and adapt to the challenges presented by the game. Simultaneously, players construct mental models and frameworks within their minds to comprehend and navigate the intricate dynamics of the game. These mental models serve as cognitive tools that help players understand the game's rules, objectives, and the consequences of their actions (Gee, 2014). What makes this phenomenon particu-

larly intriguing is that these mental models and problem-solving skills developed within the context of video games can readily transfer to real-life situations. Players find that the problem-solving strategies they employ in games are adaptable and applicable to various real-world scenarios.

The conversational nature of video games bears similarities to the IRF (Initiation, Response, and Feedback) model, which has long been recognized in educational contexts, particularly in classroom discourse analysis (Sinclair & Coulthard, 1975). This resemblance opens up avenues for exploring further learning applications and implications of video games' potential. The concept that video games entail not only spoken communication between players but also encompass every aspect of audio-visual (and sometimes touch-based) content as a form of communication akin to spoken language is a prominent focus within the field of visual and multimodal research (Wildfeur & Stamenkovic, 2022). Consequently, due to their inherently communicative and discursive nature, video games have garnered the attention of linguists, especially those interested in multimodality, systemic-functional linguistics, social semiotics, and various subfields of discourse analysis.

If we consider a video game as akin to a communicative process, the proposed communicative roles would include video game rules, video gameplay, and the player. This division of roles is motivated by the communication model introduced by the linguist Roman Jakobson (1960, 1966). In any communication, the addresser sends a message to the addressee within a specific external context, utilizing a particular contact/channel, and sharing the same code (see Fig. 1).

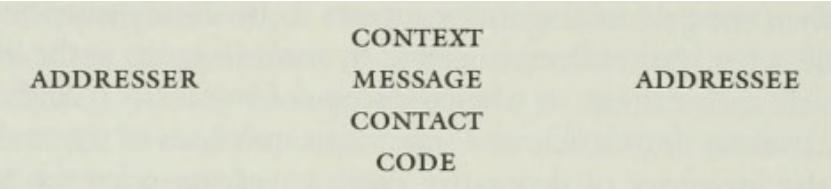

Fig. 1. Jakobson's model of communication (1960)

Language (here we refer to it as communication) serves various functions: the emotive function pertains to the addresser, the referential function encompasses the context, the poetic function focuses on the message itself, the phatic function relates to the contact, the metalinguistic function deals with the code, and the conative function pertains to the addressee (see Fig. 2).

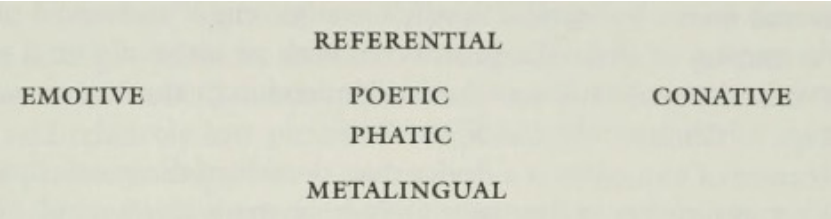

Fig. 2. Jabobson's language functions (1960)

Therefore, Jakobson's communication model (1966) and Sinclair & Coulthard model of classroom exchange (1975), when applied to the context of video games, might take the following form:

> The addresser corresponds to the game's author, but more abstractly, it represents the game rules that initiate the entire communication process (I) and subsequent exchanges. The addressee, naturally, is the player who responds through gameplay (R-response, which also aligns with Jakobson's notion of a message). The game itself continues the communication with its responses (F-feedback), contributing to the ongoing gameplay experience. Consequently, the primary focus lies in the collaborative creation of gameplay (or message), continually molded by the player's decisions and responses in conjunction with the initial game rules.

While we characterize the addresser here as the game itself rather than its author, we choose to retain the personalized role of the player. This choice acknowledges that, in the video games, often regarded as open texts par excellence, game rules must have been crafted with a "model player" in mind, similar to Eco's (1979) concept of a "model reader." This perspective aligns

with concepts that have emerged within the field of ludology, particularly within the framework of procedural rhetorics. This branch emphasizes the significance and relevance of game rules and mechanisms as the primary signifiers of a video game's meaning. It draws upon semiotic concepts rooted in the theories of Peirce, Eco, Greimas, Fabbri, among others (Pérez-Latorre et al., 2016). The communicative process and corresponding distribution of communicative functions proposed in Fig. 3.

COMMUNICATION ROLES (WHO, WHAT)	Game rules	Player	Game play
COMMUNICATION PROCESS (HOW)	Initiation	Response	Feedback
COMMUNICATIVE FUNCTIONS (WHY, WHAT FOR)	Emotive Referential	Conative Phatic	Referential Poetic Phatic Metalingual

Fig. 3. Communication in a video game

As communication in a video game flows bidirectionally and is less asymmetric compared to the teacher-student relationship model (IRF) from which we drew inspiration, we can represent the entire process using a triangle, as depicted in Fig. 4.

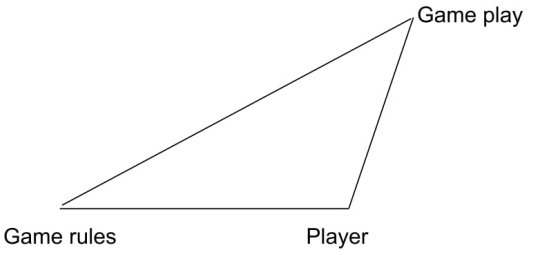

Fig. 4. l Towards the model for serious video game analysis, part 1: Video game as a communicative process

For all of these reasons, their conversational nature and cognitive motivators, the video games potential in enhancing both the teaching and learning is worth exploring. Given the games' communicative potential, the video games might be analysed from linguistic and pragmatic perspectives. In this context, the mechanisms of the social semiotics, deeply motivated by the concepts of the systemic-functional linguistics, are here to be examined.

Video games analysis: Towards social semiotic perspectives

As previously mentioned, the analysis of video games, like the study of any cultural creations, can be approached from various angles, depending on the research goals and questions. Video game studies is a relatively new field, and it is still in the process of developing its methods for analysis.

Early research in gaming studies in general was marked by a conflict between two main approaches: narratology and ludology. Narratology, the first approach, tried to apply methods borrowed from literary studies to analyze video games, as shown by the work of Murray (2005). Ludology, on the other hand, focused primarily on the mechanics and rules of gameplay rather than the visual and representational aspects, considering them less important, as argued by Murray in 2005. While narratology emphasized storytelling and the final product, ludology concentrated on the interactive process of playing the game. Over time, this conflict has been largely resolved, as indicated by Ryan in 2006, but the field is still refining its analytical tools.

As highlighted by Lim and Toh in their 2022 research, digital play opens up exciting possibilities for children, including enjoyable multimedia experiences, increased control over their actions within games, and the incorporation of game elements to maintain their interest. The same position is shared by Matumoto and Gonçalves-Segundo (2023) who emphasise the games "potential for meaning-making, as they dynamically combine different semiotic modes and allow players to be an active part of

this semogenetic process, expanding opportunities to tell stories, interact with people, have fun, and learn." (Matumoto and Gonçalves-Segundo, 2023). This not only holds significant potential for educational and developmental purposes but also underscores the need for effective theories and methods to comprehend and harness this emerging potential.

In the context of digital play, the concept of meaning-making unfolds through the use of diverse semiotic resources and modes, offering a deeper insight into how children engage with and learn from digital experiences. Computers, tablets, and smartphones aren't merely digital tools; they are true "cultural tools" (Vygotsky, 1978 in Lim & Toh, 2022). They enhance children's thinking, creativity, and internalization of cultural norms (Given et al., 2016 in Lim & Toh, 2022). These devices facilitate "new ways of conceptualizing the world, which become integrated into the child's inner conceptual resources" (Garvis, 2018 in Lim & Toh, 2022). In today's learning landscape, they have become indispensable, aiding children in developing their thinking, creativity, understanding social and cultural norms, and enabling them to view the world from fresh perspectives that become an integral part of their cognition. Learning occurs when a child's entire toolkit, including these digital resources, expands and evolves. In simpler terms, when kids use digital devices and other tools for learning, it's not just about acquiring new knowledge; it's also about transforming the way they think and perceive the world. It's akin to adding new tools to their mental toolbox and using them to construct a more profound understanding of the world (Lim & Toh, 2022, p. 3).

More specifically, "learning takes place when the child's entire set of resources is augmented and transformed" (Lim and Toh, 2022). This serves as the driving force behind our discussion. Hence, this study is motivated by the pressing need to comprehensively explore as many potential semiotic resources as possible involved in this transformative process.

As reported by previous studies, children at risk for developmental dyslexia might have "impairments in visual spatial

attention and speech-sound segmentation" (Facoetti et al. 2010 in Gaggi et al). Previous research studies (Gabrieli, 2009; Franceschini et al., 2013; Lyytinen et al, 2007; Gaggi et al.) have consistently affirmed the advantages of using video games as potent stimuli for enhancing phonological skills and visual spatial attention, which are pivotal in the treatment of dyslexia (Gabrieli, 2009; Facoetti et al., 2003). However, these studies have primarily focused on the benefits of video games without delving deeply into the specific characteristics these games might possess. For instance, some research findings have indicated that employing "extra-large spacing between letters improves reading efficiency in dyslexic children with consistent and inconsistent orthographies" (Zorzi et al., 2012 as cited in Gaggi et al.). Consequently, these findings have led to the conclusion that "engaging in computer games that train visual spatial and cross-modal temporal attention mechanisms can enhance the reading abilities of individuals with dyslexia" (Franceschini et al., 2013; Lyytinen et al., 2007 as cited in Gaggi et al.). However, despite these valuable insights, there remains a notable gap in our understanding of the specific semiotic resources employed within these games.

There is an impression that many of the currently available free online learning apps predominantly employ a 2D, enigmatic, and somewhat mechanical approach, often aligning with the concept of 'ludus' as described by Caillois (1958/1979). This impression is based on even a cursory examination of the most accessible serious games available and other freely accessible online tools. In many cases, it appears that most of these games (if not all) rely on simple narratives (e.g., a fish evading a shark) primarily as background stories rather than immersive factors. The prevalent semiotic resources often lean heavily toward the visual domain, utilizing elements such as colors and shapes, while audio frequently consists of computerized voices. Kinesthetic elements are typically limited to basic drawing. Some of these apps even incorporate elements of 'agon,' introducing competition, whether against time or other players. However, this approach stands in contrast to 'paideia,' which encourages open and cre-

ative gameplay with a stronger emphasis on the player's autonomy

While there are valid reasons for emphasizing controlled outcomes, as exemplified by 'ludus,' we are intrigued by the prospect of developing more detailed methodological frameworks that explore a broader array of semiotic resources. We are particularly interested in those resources commonly utilized in freely accessible online video games. Our motivation for this study is further bolstered by recent research findings, which suggest that even action games can enhance reading abilities, phonological decoding speed, and phonological short-term memory in children with developmental dyslexia (Franceschini & Beroni, 2018). It is worth noting that action games tend to align more with the 'paideia' concept, offering greater creative freedom and encompassing a wider range of semiotic audio-visual resources.

The valuable perspective in research capable of filling the above mentioned research gap might be offered by social semiotics, which establishes a clear connection between the content of a video game and how that content is expressed. However, while social semiotics acknowledges the arbitrariness between content and expression (Halliday, 1978: 44), it firmly asserts that the relationship between semantics and grammar is highly systematic (Halliday, 1978: 45). This suggests a motivation for the link between meaning-making and the functionality of communication elements. In essence, it implies that the structuring and combination of words in a language are not random; rather, they adhere to rules and patterns intricately tied to the conveyed meaning. This relationship is not arbitrary, unlike the general linguistic connection between the signifier and signified. Instead of arbitrariness, social semiotics seeks to illuminate the multimodality and functionality of specific resources. Rooted in particular social contexts, notably within learning and development domains, social semiotics delves deeply into the aforementioned process of meaning-making. This perspective introduces a new dimension to learning, shifting away from more traditional cognitivist and constructivist approaches toward a prevailing le-

arning paradigm for the digital age known as connectivism, as articulated by Siemens in 2005. In this form of learning, especially within digital environments, meaning is constructed through a combination of diverse semiotic elements, including speech, written language, gestures, gaze, eye contact, physical positioning, and movement (Bezemer et al., 2012).

Unlike the general linguistic notions of arbitrary, the social semiotics recognise the social motivation in each sign, therefore the meanings are always socially related (Kress, 2004).

> The 'social' in 'Social Semiotics' draws attention to the fact that meanings always relate to specific societies and their cultures, and to the meanings of the members of those cultures. Semiotics takes the sign—a fusion of a form and a meaning—as its basic unit. In making signs, we—embedded in our cultures—select forms in such a way that they express the meanings that we 'have' always 'aptly'; hence signs always express, through their form, the meanings that the makers of signs have wished to make. (Kress, 2004, p. 111).

Social semiotics has moved beyond the structuralist approach, which primarily looks at how parts within a closed system relate to each other. Instead, it delves into how symbols are employed within specific social contexts. Structuralist semioticians focus on how elements relate to each other, while social semioticians place importance on how readers attribute significance to symbols in a text. They also consider the rules governing the text and highlight the role of the semiotic context in creating meaning (Long & He, 2021). According to van Leeuwen (2005), the semioticians perform these three kinds of activities:

> 1. collect, document and systematically catalogue semiotic resources – including their history
> 2. investigate how these resources are used in specific historical, cultural and institutional
> contexts, and how people talk about them in these contexts – plan them, teach them, justify them, critique them, etc.
> 3. contribute to the discovery and development of new semiotic

resources and new uses of existing semiotic resources. (van Leeuwen, 2005, p. 3)

The primary focus of this discussion pertains mainly to the initial activities. The study aims to highlight the key semiotic resources and their functions, organising them into an open system and inviting for their further applications. Furthermore, the study would offer a systematised analytical model that might further shed light on the present utilization of semiotic resources in the most commonly used online video games for dyslexia treatment. The proposed model will hopefully broaden our understanding of additional semiotic resources rich in potential for facilitating meaningful learning and development.

Serious video games: Towards a Social Semiotics Analytical Model

Several attempts have been made to apply social semiotics' tools to the analysis of video games. The pioneering work was done by Burn (2010), who used Halliday's metafunctions (1978) to analyze video game design. Burn's framework encompasses Halliday's three metafunctions: representational, interactional, and compositional. Burn (2010) explains how video games represent things, how players interact with them, and how video games are created in a coherent and cohesive structure. Another, more recent model was proposed by Latorre, Oliva, and Besalú in 2016, which particularly emphasizes the connection between narrative and gameplay in video games. It considers elements such as audiovisual storytelling and game design, categorizing these aspects according to Halliday's metafunctions, which include the representation of experiences, the composition of textual elements, and interpersonal interactions within the game. This model helps researchers understand how different components of a video game contribute to its overall meaning and expression. Finally, Lim & Toh (2022) developed a metafunctional framework for analyzing educatio-

nal apps for English language learning. Lim & Toh's (2022) framework is deeply rooted in multimodal social semiotics (Kress, 2011) and is significantly inspired and firmly connected with systemic functional theory (Halliday, 1978; 2004).

Motivated by the works of early analysts, particularly those who highlighted the need for clearer definitions, a functionalist approach, and a more interdisciplinary analysis (Frasca, 1999), we chose to combine previously applied concepts uniquely.

The previous analytical models were heavily influenced by systemic-functional linguistics and Halliday's metafunctions (ideational, interpersonal, and textual). However, social semiotics diverges from the traditional focus on semiotic signs to emphasize the broader concept of semiotic resources, which can vary depending on the specific textual example. In our approach, we sought to incorporate not only the metafunctions and textual multimodality of semiotic resources but also the communicative aspect of video games. This integration has resulted in a final model that can be visualized as a three-dimensional pyramid—an object that offers numerous intersections and insights.

We drew inspiration from prominent scholars such as Jakobson, Halliday, and Kress & van Leeuwen, whose ideas shaped our conceptual framework. This framework encompasses language and communicative functions, metafunctions, and the multimodality of semiotic resources. The three-dimensional pyramid serves as both a visual representation and a metaphor for the numerous and continuous interrelations among these constitutive elements. Rather than attempting to compile an exhaustive list of all elements contributing to meaning creation, which would inevitably be flawed and incomplete, our intention is to provide a versatile tool that can be adapted, refined, challenged, and tested in various contexts and situations.

Communication process (Jakobson)

The foundation of the pyramid is represented by an earlier introduced communication model (game rules - player - game-

play). Here the potential inquiry should revolve around these questions:

Initiation:
1. What are the most important game rules?
2. How does the game function?
3. What is expected from a player?

Exploring the initiation of the communication process in video game might predominately allies with Jakobson's emotive function, focusing on the addresser (in this case the game itself),and the referential language function, which encompasses the message within the external context and world representations.

Response: (player)
1. What is the expected response from the player?
2. Are there any alternative responses?
3.

The player's response activates the conative linguistic function, signifying the player's physical and emotional response to the game rules and mechanics. This phase may also entail observing the player's behavior and tailoring the research accordingly. Furthermore, in addition to the already mentioned emotive function, it also triggers the phatic function, which is concerned with the player's interaction with the device and the medium channel.

Feedback: (game play)
1. How does the player's responses influence the game?
2. Are there any alternative flows?

At this stage, all the previous language functions converge. The game and the gamer must share the same code and recognize the same metalinguistic function to ensure the game's continuation. Throughout the different stages of the communicative process, various Jakobson's functions are activated in the following sequence: emotive, referential, conative, phatic, and metalinguistic.

Communication metafunctions (Halliday)

Based on this framework, we can associate each point of the triangle with one of Halliday's metafunctions: ideational, interpersonal, and textual (Fig. 5). These three metafunctions converge at a single point of intersection, offering various interpretational possibilities.

The ideational metafunction is suggested to originate from the game rules point of the fundamental triangle since it pertains to the external and given reality, with the game rules considered as given and forming part of the contextual background of the communication. The interpersonal metafunction is linked to the player, and the textual metafunction is associated with the gameplay. However, given the intersecting nature of these metafunctions and their eventual convergence at the apex of the pyramid, alternative combinations are also feasible. As Halliday (1978, p. 47) explains, the metafunctions represent "areas of meaning potential inherently involved in all uses of language." Therefore, it is essential to select a visual representation that aligns with the omnipresence of these functions, and the four-sided pyramid could serve as an illustrative representation. However, the choice may depend on the specific research objectives, questions, and the type of video game under analysis.

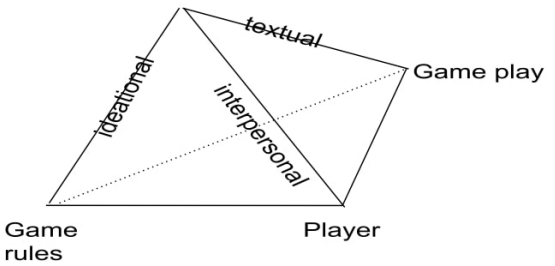

Fig. 5. Towards the model for serious video game analysis, part 2: Video game as a communicative process and language functions + language metafunctions

While the previous studies have heavily relied on Halliday's metafunctions, it is essential to provide further context and justification for their application.These three metafunctions are inherent to any communicative event, they are built into language itself (Halliday, 1978, p. 47) and "form the basis of organization of the entire linguistic system" (Halliday, 1978, p.47).

The ideational metafunction pertains to something external, it refers to the something given, belonging to the world even beyond language itself. It is similar to Jakobson referential (1960) and Bühler (1934 in Halliday & Hasan, 1989) representational, Malinowski (1923 in Halliday & Hasan) pragmatic (narrative), Britton's (1970) transactional (informative) functions. Halliday divides it into two components: the experiential which deals with content, encompassing the "expression of the processes and other phenomena of the external world" (Halliday, 1978, p. 49). This includes the external reality and also the speaker's internal realm of thoughts and emotions ("speaker's own consciousness, the world of thoughts, feelings and so on" Halliday, 1978, p. 49) . The second component is the logical aspect, which encompasses all kinds of recursive structures, parataxis, coordination, apposition etc, or hypotaxis, like spatial, temporal, causal, or other types of connections and relationships, including the conditional statements and reported speech. The ideational metafunction defines the textual field, and therefore, here it is most relatable to the game as a game mechanism and rules themselves. The game acts as both a product and an addresser in this communicative event.

> The ideational function represents the speaker's meaning potential as an observer. It is the content function of language, language as 'about something'. This is the component through which the language encodes the cultural experience, and the speaker encodes his own individual experience as a member of the culture. It expresses the phenomena of the environment:the things-creatures, objects, actions, events^ qualities, states aad relations -of the worid and of our own consciousness, including the phenomenon of language itself; and also the *metaphenomena,

> the things that are already encoded as facts and as reports. All these are part of the ideational meaning of language. (Halliday, 1979, p. 112).

Applying these concepts to the video games, the ideational function can be understood as a video game's ability to convey its intended meaning to players, akin to how language communicates information. In this context, it represents the content aspect of video games, as they are essentially "about something." It serves as the component through which video games encode cultural experiences and enable players to encode their individual experiences within the game world. The ideational function functions as a means to express various elements of the game environment, including characters, objects, actions, events, qualities, states, and relationships, as well as the game's own mechanics and narrative. Additionally, it encompasses what can be considered "metaphenomena" in video games—those aspects that are pre-established as facts or reports within the game's universe. Collectively, these elements contribute to the ideational meaning of a video game.

Some of the leading questions might be directed towards a simple definition of a so-called *field* of the game (predominantly the questions that start with who/what, where, when):

- What does the game represent? Which elements of the external reality are depicted?
- Who are the game's protagonists?
- What is the game about on the most observable level? What are the main objectives and purposes of this game? (e.g., a shark going after a fish)
- What is the context? Where is the general setting of the game situated?

Additional questions to further enhance ideational analysis:

- Why does the narrative progress in a certain direction? (e.g., a shark goes after a fish to eat it)

- How does the story progress?

The role of interpersonal metafunction is to establish the connection between the game and the player. It also establishes the tenor of the communication.

> The interpersonal component represents the speaker's meaning potential as an intruder. It is the participatory function of language, language as doing something. This is the component through which the speaker intrudes himself into the context of situation, both expressing his own altitudes and judgements and seeking to influence the attitudes and behaviour of others. It expresses the role relationships associated with the situation, including those that are defined by language itself, relationships of question respondent intformer-doubter and the like. These constitute the interpersonal meaning of language. (Halliday, 1979, p. 112).

In the context of video games, the interpersonal component plays a pivotal role in shaping player engagement and interaction. Just as language empowers individuals to take actions and engage in conversations, video games empower players to actively participate in the game's storyline and virtual world. This component facilitates players in expressing their preferences, making choices, and impacting the game's outcomes, much like how language permits individuals to voice their opinions and sway others. Moreover, it recognizes the significance of relationships that can develop within a game, emphasizing the intricacy and depth of player interactions, both within the game itself and within the larger gaming community. This dimension enhances the overall gaming experience and underscores the social and interactive essence of video games.

Some of the analytical questions here might be:

- How does the game communicate with a player?
- How the information between tha game rules and the player are exchanged? Is it an imperative, a permission, a kind request, etc?
- What kind of pronouns are used?
- What kind of a voice?

- What is the overall tone and tenor of the communication?
- How does the player respond?

The role of the textual metafunction in a video game, just like in any other "text" of popular culture is to enable its cohesion and coherence, its composition and natural flow.

According to Halliday the textual metafunction

> Represents the speaker's text-forming potential; it is that which makes language relevant. This is the component which provides the texture; that which makes the difference between language that is suspended in vacuo and language that is operational in a context of situation. It expresses the relation of the language to its environment, including both the verbal environment – what has been said or written before – and the nonverbaJ, situational environment. Hence the textual component *has an enabling function with respect to the other two; it is only in combination with textual meanings that ideatioNal and interpersonal meanings are actualized*." (Halliday, 1979, p. 113).

In video games, the concept of the textual metafunction, as outlined by Halliday, underscores the significance of cohesion and coherence in crafting a captivating gaming encounter. It transcends mere gameplay mechanics or graphical elements; it delves into the structuring of the game's language, storytelling, and world-building to fully engage players in the game's universe. Game developers meticulously assess how the game's language aligns with the in-game setting and the actions taken by the player, thereby shaping the overall player experience. This dimension accentuates the pivotal role played by narrative design, dialogues, and textual components in transforming video games from mere forms of entertainment into immersive interactive adventures.

- What elements are used to create a sense of coherence and flow in the game's storyline?
- How is the gameplay organised? What is the beginning, the

main part and the conclusion of the videogame?
- How are the different stages in the video game connected?
- Is there any connection between the levels?
- Is the entire game one whole entity? Etc.

These three metafunctions align with the three distinct components of social context: field, tenor, and mode. Field unveils external social processes, tenor pertains to social relationships, and mode encompasses a symbolic mode of communication. These Halliday's concepts find resonance with the metafunctions when applied to the various elements within video games, as illustrated in Fig. 6.

Component of social context	**Functional-semantic component through which typically realized**	**Video game component**
1. Field (social process)	Experiential	Game rules, mechanics, game narrative
2. Tenor (social relationship)	Interpersonal	Player / Game interaction
3. Mode (symbolic mode)	Textual	Game play organisation

Fig. 6. Social context, metafunctions and game elements

Semiotic resources (Kress & van Leeuwen)

Semiotic resources refer to "the actions, materials and artifacts we use for communicative purposes, whether produced physiologically—for example, with our vocal apparatus, the muscles we use to make facial expressions and gestures—or technologically—for example, with pen and ink, or computer hardware and software—together with the ways in which these resources can be organized" (van Leeuwen, 2005). Besides, "Semiotic resources have a meaning potential, based on their past uses, and a

set of affordances based on their possible uses, and these will be actualized in concrete social contexts where their use is subject to some form of semiotic regime" (van Leeuwen, 2005, p. 285). In social semiotics, the focus shifts from the conventional view of signs as "signifier" and "signified" to emphasize the concepts of "semiotic resource" and "signifying potential." This perspective draws inspiration from Halliday's theory of language as a "resource for making meanings" rather than merely a set of rules for generating correct sentences (Halliday, 1978, as cited in van Leeuwen, 2005, p. 3).

In the literature, there is a plenitude of semiotic resources recognised, and listing all of them would be an impossible task. In the domain of video games, in defining the main semiotic resources and their meaning making potential, we might start from the human senses, so the main senses in video games are sight, hearing, and tactile. With virtual reality, the list of activated senses might be expanded to taste and smell, as well. Limiting our model to classical serious video games, available on the computer, tablets, or smartphones, the semiotic resources are divided into visual, auditory, and kinesthetic groups.

Approaching the semiotic resources in this study focuses primarily on their structural potential as compositional elements within the entire game. As a result, we aim for a straightforward, although much limited, presentation of visual, auditory and kinesthetic elements, as potential meaning making contributors.

Within the realm of visual semiotic resources, we find a range of elements that significantly contribute to the overall meaning-making process. These include factors such as color, size, placement, salience, framing, emphasis, and point-of-view. In the case of serious video games, it is assumed that the main visual semiotic resources in the overall visual compositions are size, colour, shape and typography. All these elements might have all the three metafunctions (ideational, interpersonal and textual). Although in the past there were attempts to address to the colours some universal meanings, those meanings do vary in different times, places and cultural contexts. The visual se-

miotic resources within serious video games are organised into compositions with their own structure and pathways. Therefore, the first analytical questions, outlined similary also by Holmes (2013), might be related to the overall visual architecture (Lim & Toh, 2022), e.g.

> How are the elements arranged? How are they related to each other? What is emphasized, and how? (Holmes, 2013).

Some additional questions might be What is the overall framing? What is the player's pathway? How is the player moving along the game?

Van Leuween also describes how different elements depend on each other, and he explains the terms like segregation, separation, integration, overlap, rhyme, contrast (van Leuween, 2005). In this stage, Holmes (2013) suggests to pay attention to the following questions:

> What is the color palette of the game? What does this indicate to you? What is the point-of-view of the game, and how do you relate to the game through this perspective? How are these elements represented in other games? How does that influence how you understand them, and act in the game? How are these elements presented outside of the game? Does the game conform to these extra-game conventions or does it challenge them? (Holmes, 2013)

Different groups of people use color in various ways, and these groups often have specific, specialized purposes for using color. Unlike language or well-established visual communication systems, which are used by large populations, the way color is used can be unique to smaller groups. However, if we consider that what people do with color shapes how they use it, we can better understand its role in communication. By connecting the meanings of colors to how they look and what people do with them, we can ask important questions like: Is color a unique way of representing things? Does it offer all the possibilities we need

for communication? So, the challenge is to study how different groups use color regularly and understand it well enough to explain the principles that guide their use of color in their communication. This way, we can start to uncover general principles about how color works in communication and, more broadly, how signs and symbols function in various cultural contexts. (Kress & van Leeuwen, 1996).

These visual components play a pivotal role in shaping how we perceive and interpret visual information. Our understanding of these elements is heavily influenced by the work of scholars like Kress and van Leeuwen (1996), who have delved into the intricate workings of visual communication.

Turning our attention to the auditory aspects, we scrutinize a diverse array of sound components, including voice, pitch, timber, sound effects, and music, among others. Questions arise regarding how sound is employed within the game:

- Is the player required to speak or interact vocally with the game?
- Does the game itself use speech or other auditory cues to provide instructions or feedback?
- Is the voice of the game instructor presented in a human-like manner, or is it more mechanized?

These inquiries help unravel the role of auditory elements in the overall gaming experience.

Additionally, the kinesthetic resources involve the player's physical movements and interactions. For instance:

- Does the player need to draw or make specific physical gestures on the device to progress in the game?
- What physical movements the player is asked to perform? What kind of device is the player using (a keyboard, a tablet, a console, etc)? Are there any meaning making resources available on those devices and how are those being activated?
- How is the transition from one level to another orchestrated, and how does it involve the player's movements?

These questions delve into the embodied aspects of gameplay and their significance in the gaming process.

It is important to emphasize that these semiotic resources should not be analyzed in isolation but rather holistically. This holistic approach considers the experiential, interpersonal, and textual dimensions, allowing us to comprehensively grasp how these resources interact to create meaning within the gaming context.

Combining all three constitutional segments into one illustrative and integrative model, the tri dimensional pyramid obtains the look as presented in the Fig. 7

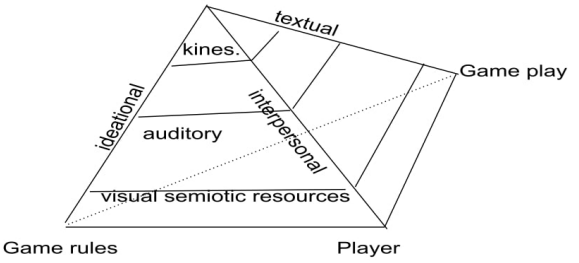

Fig. 7. Towards the model for serious video game analysis, part 3: The social semiotic model for serious video game analysis

The fundamental principle underlying our proposed model is not its exhaustive completeness, the singular positioning of various elements, or their universal applications. Instead, it lies in the unique feature of this model, which allows for the intersection of almost all the identified components. Think of it as resembling the renowned toy Pyraminx or a triangular version of Rubik's Cube, a three-layered pyramid in the shape of a tetrahedron. Similar to this famous puzzle, each element within our model can be positioned differently, creating consistent intersections that offer the potential for exploration and deeper

understanding. Furthermore, akin to cutting a cake, each piece obtained through this model should ideally encompass and address all the integrative components, ensuring a holistic understanding of the complex interplay within serious video games.

Conclusion

The main intention of this paper was to discuss the methodological potential of social semiotics in creating analytical models for understanding the meaningful resources that can be derived from serious games.

Having thoroughly examined serious video games as a contemporary extension of the *serio ludere* concept, serving educational and developmental purposes, and functioning as a rich form of communication laden with diverse layers of semiotic resources for meaning-making, we introduce our analytical model. This model draws from the realms of communication studies, systemic functional linguistics, and social semiotics. Presented visually as a three-layered pyramid, it facilitates the examination and interpretation of the interconnected relationships among various components: the participants in the communicative process, the social and communicative functions (derived from Jakobson's theories), the communicative metafunctions that serve as heuristic tools, and, lastly, the semiotic resources or modes that form a crucial link between form and content, departing from the classical Saussurian notion of arbitrariness.

The insights and conclusions offered in this paper make significant contributions to our broader comprehension of serious games as instruments for communication, learning, and self-expression. Additionally, they underscore the vital role of social semiotics in deciphering and interpreting the intricate interactions and messages that unfold within these digital environments. However, it is important to acknowledge that this model, like any analytical framework, has its limitations and potential downsides. While it offers a tool for understanding the

complexities of meaning making in serious video games, it may not capture all aspects of their semiotic richness, and its applicability could vary depending on the specific context and type of game under analysis. Researchers and analysts should approach its use with a critical awareness of its scope and potential constraints. The application of the model to analysis of some of the recent serious games might reveal some further adjustments and adaptations.

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Life-Up! Supporting mental health and wellbeing with video games

by G. Virgilio

Introduction

This chapter discusses the application of video games to perceive clinical issues. The case of Video Game Therapy® is taken as an example to present how commercial video games are well-suited for this purpose, along applied games too. A brief history of video games' perception in the population and in the scientific literature is presented at first: video games were once faulted to badly influence aggression's perception in the youngest and consequently their behavior. It is exposed how this perspective changed in the recent years, along all the good reasons to confirm a positive view on video games. Then, the discussed benefits provided by video gaming will be linked to the possibility of enhancing psychological wellbeing. Specific applied games will be analyzed, and it will be discussed the possibility to perceive the same issue through commercial video games. Then, Video Game Therapy® will be introduced.

Video Game Therapy® is a clinical approach, enveloped within the framework of Adlerian psychodynamic psychotherapy. The influence of Alfred Adler's work on this therapeutic approach will be considered, as well as those scientific basis derived from studies demonstrating the positive effects of video games on learning and behavior in various contexts. The central focus is on the unique aspects of Video Game Therapy®. It underlines the importance of the therapeutic alliance and the state of Flow, drawing on Csikszentmihalyi's concept. The text explains how this approach allows users, including children, adolescents and adults, to express themselves in a protected and enjoyable context. The therapeutic process involves selecting a

video game based on the patient's personality, followed by an immersive phase to explore emotions and thoughts. Video Gaming Allows the players to experience and overcome failure, promoting a sense of competence and control. The collaborative relationship between therapist and patient is emphasized, leading to the co-creation of a new logic and lifestyle.

The text concludes by acknowledging Video Game Therapy® as a novel psychotherapeutic approach that integrates various theoretical elements and offers insights applicable not only in clinical settings but also in education. This chapter explores Video Game Therapy® in detail, providing not only a comprehensive overview of its principles and implications, but, most importantly, further suggestions to better integrate video games in the relationship between youngers and caregivers in general. In facts, adults and educators are encouraged to engage with video games as a shared communication tool, emphasizing the positive aspects of gaming, such as Flow, suspension of judgment, and the transfer of learning to real-life situations. Video games can therefore become a precious ally to monitor a younger's psychological wellbeing, and to promote positive outcomes in this field.

"Video games are harmful, science said!"

Video games are very popular nowadays, to the extent that the video game industry itself generates substantial profits. Such widespread popularity is possible due to the proliferation of various electronic devices that incorporate gaming platforms: common tools like smartphones or PCs allow a high percentage of the population to enjoy video games, many of which are free-to-play (IIDEA, 2021; 2022).

It wasn't like this about thirty years ago, when playing video games required inserting tokens purchased at the arcade counter, or owning home entertainment consoles. The increase in the diffusion of video games began even then, attracting the attention of psychology researchers, generally skeptical about the gaming

tools. There were significant scientific studies alarming readers about the potential harmful effects of video games, perceived as an educational risk for users, especially the younger ones (Virgilio, 2019).

Albert Bandura (1977) elaborated the social learning theory, which suggested that children tend to replicate aggressive behaviors exhibited by others. It was feared that allowing children to take on the digital roles of characters rewarded for their aggressive acts would desensitize them to violence, and lead to deviant behaviors. Were they right? It's better to proceed in order.

Following Bandura's theory, several studies claimed to have identified a correlation between exposure to video games with aggressive content and violent behavior, as well as increased insensitivity to the display of deviant or offensive behaviors towards others. Studies conducted by Professor Craig Anderson are famous in this regard, representing a school of thought that considers playing video games a risky activity for young people: the consolidation of an attitude that views retaliation as an acceptable mode of response to provocations (2004), desensitization to violence (Anderson, Shibuya, Ihori, Swing, Bushman, Sakamoto, et al., 2010), and long-term negative behavioral effects following prolonged exposure (Gentile & Stone, 2005) are the main effects he believes violent video games would have on users.

Common sense looked at video games with suspicion, even though there was no overwhelming evidence of their harmfulness. People who expressed this distrust towards video games could state their prejudices with a generic and misleading "they're harmful, science said!". In this regard, I personally remember an exemplary event, which has also been mentioned in a book (Triberti & Argenton, 2013): watching television, I witnessed a news report that told the story of a boy; after spending many hours playing video games, the young man allegedly began wandering the streets in a confused state, believing he was really one of the characters he had just played. Even though I was not yet ten years old, I remember how my parents took that

news to warn me, as an avid gamer, that it would be wise for me to respect the agreed-upon gaming times with them, to avoid ending up like that poor boy.

We have evidence that video games do not cause brain damage in their users, and we also know that they certainly cannot compromise one's reality perception. As suggested by the authors, it is more likely that the event reported by that news was a misunderstood episode of psychosis, that had affected a very young boy. Such an event can manifest in various ways, and certainly cannot stem from the enjoyment of video games (Virgilio, 2019). Video games were badly considered until recently, not only by common sense but also by scientific literature. It took many years for the negativity surrounding video games to be dispelled.

Video games are not harmful at all

Although there was once a predominantly skeptical trend in scientific literature regarding video games, claiming they had negative effects on health and behavior, it is equally true that there have been opposite considerations over the years. Around the 2010s, the results suggesting that video games make their users violent were seriously questioned.

Taking Christopher Ferguson's meta-analysis (2007) as an example, the conclusions that assumed a correlation between video games with aggressive content and increased violent behavioral expression by gamers were disconfirmed. Ferguson emphasized how many of these studies had faulty assumptions: in many researches, potentially confusing elements were found; actions that could not be considered aggressive in any way, were considered "violent", such as the simple jump of an avatar over an enemy's head, causing a subsequent disappearance of the enemy itself.

Furthermore, Ferguson pointed out that many studies overlooked the calculation of effect size, a probabilistic coefficient that allows the generalization of investigated effects in an exper-

imental sample to the population with the least possible error. In his meta-analysis, Ferguson included only those studies that focused on video games with genuinely violent content and ensured the calculation of effect size. The data did not confirm the initially asserted idea: video games with aggressive content do not negatively influence their users.

Ferguson's conclusions were supported by subsequent studies. A study by Szycik, Mohammadi, Münte, and te Wildt (2017), conducted with fMRI, found that in gamers accustomed to daily and intensive use of violent video games, the brain areas responsible for controlling aggression and empathy showed no alterations, appearing entirely similar to those of people not accustomed to gaming at all. In another experiment, the aggressive behavior of people who played the violent video game Grand Theft Auto V every day for two months was equivalent to that of the group that played the calmer and more altruistic The Sims 3. It did not even differ from the behavior of the control group, consisting of people who had not played video games during that period.

To conclude the exploration of possible negative influences of video games with aggressive content, it is mentioned a study by Przybylski and Weinstein (2019). The research involved over a thousand British adolescents aged 14 to 15 and their parents. The young participants, in addition to answering a questionnaire assessing aggression levels, provided a report on their gaming activities, including the average gaming time and the titles of the three video games they played the most in the last month. From this list, the authors classified the video games according to the PEGI classification, focusing on those that featured the famous "violent content" symbol. Additionally, parents of participants were asked to complete a questionnaire assessing their children's aggressive behavior from their point of view, and other specific questions were asked to investigate prosocial behavior. The researchers found no correlation between aggressive behavior, prosocial behavior, and the use of violent video games in this sample. Great care was taken in the statistical control, respecting

elements that had been overlooked in previous similar studies.

What value can we attribute, then, to those studies that argued for the real negative influence of video games with violent content? Is it just a futile effort that we can overlook? Not at all. We can say that they identified in this type of video game a small source of aggression, but not a potential deviant element. Aggression that video games certainly elicit, but it tends to dissipate after a few minutes following the end of the gaming session (Triberti & Argenton, 2013).

Video games have benefits as well

But what is the current prevailing view on video games? Over the years, it has been discovered that we don't need to fear video games. On the contrary, scientific literature highlights studies suggesting that video games may not be educational tools in a negative sense; instead, they could potentially be positive for users. Numerous studies testify to the improvement effects of video game use in certain cognitive areas: problem-solving strategies, memory, attention, eye-hand coordination, and creativity. These are just some of the life skills that video games seem to enhance.

Researchers have shifted their focus to the potential benefits of video games for their users. The emphasis on video games as empowering and improving tools should not lead us to the risk of polarization: just as common sense has long feared video games, framing them as an "all-bad" element, we should not fall into the trap of viewing this medium as "all-good" alone. In other words, it would be wise for us to avoid simplistic polarizations or thoughtlessly extreme viewpoints that easily permeate social thinking. Avoiding polarizing our view of video games does not, of course, mean denying the actual results achieved by research, both regarding the potential risks associated with the use and abuse of video games (especially gaming addiction) and their benefits.

As for the positive effects of the video game medium, the re-

sults of various studies have encouraged the experimentation of using video games in non-primary gaming contexts. This is the case with so-called serious games, specifically designed to help users acquire specific knowledge. Examples include flight simulators and video games developed to assist individuals with specific learning disorders. For instance, Letter Ninja, developed by the University of Salerno in collaboration with the Open University of Catalonia and the University of Bergamo, aims to identify the correct letter in the shortest time possible, enhancing letter recognition skills. Players with ASD (Autism Spectrum Disorder) showed improvement in letter recognition, a skill typically compromised in these individuals and in need of enhancement (Di Tore, Lazzari, Jordi & Sibilio, 2017). The improvements of some individuals with ASD following the use of video games are well-documented (Tore, Fulgione & Sibilio, 2014).

Not only have serious games facilitated scholastic learning, but commercial video games have also played a role. For example, a history teacher incorporated the video game Assassin's Creed into lessons to enhance the explanation of certain concepts. Assassin's Creed is a series of video games set in various historical periods, characterized by considerable graphical and historical realism (Martino, 2021).

Serious objectives

The video game Sea Hero Quest, on the other hand, was specifically developed to collect data that could help better understand cognitive decline experienced in dementia. This application, created by the British company Glitchers in 2016, in collaboration with the Alzheimer's Research Center in London, University College London, the University of East Anglia, and Deutsche Telekom, is quite simple: an old navigator is accompanied by his son on a journey to retrace the steps of a past adventure that he can no longer remember. The only memory of the adventure is an old photo album, and players must collect the

images by revisiting the original checkpoints the elderly sailor passed through.

After memorizing a starting map and the order of presented checkpoints, players must navigate the route and then indicate them in the correct sequence, without the aid of a navigation map. Referring to the accuracy of identified checkpoints and their total number, the research team could study players' spatial abilities, one of the first cognitive functions compromised in dementia. This game allowed researchers to collect a vast amount of data on the functioning of these skills in individuals, to better understand what their "normal" life cycle could be and draw conclusions useful for those experiencing cognitive decline. Researchers estimated that without this video game, the same data would have taken many years to collect (Etchells, 2016).

Some video games have been developed to promote awareness of specific issues. Developers have utilized the immersive qualities of the video game medium to place users in the shoes of people experiencing specific life conditions, fostering empathy and, consequently, more favorable attitudes towards these situations. An example is That Dragon: Cancer, an exploration game produced by the Green spouses, telling their story as parents dealing with their child's incurable disease. In this case, it's not a serious game but a genuine artistic artifact that puts players in a position to experience complex emotions through a dream-like scenario.

Another game created with the aim of raising awareness about a specific issue, in this case, sexism and sexual harassment towards women in the workplace, is Grayscale. Playing the role of a human resources manager, the player must decide how to respond to requests from some employees regarding the "inappropriate" clothing of some colleagues. How will the player act in this situation? By issuing an official warning to all female colleagues without investigating the reported incident – committing an act of indirect sexism? Or by also questioning other colleagues about the reported incident – and making more complex decisions? Developed by the Massachusetts Institute of Technology's

"the Imagination, Computation and Expression" lab, the video game encourages players to reflect on various forms of sexism, as identified by Glick and Fiske (1996), and contemplate the complexities of these dynamics.

Today, video games are used for purposes beyond pure entertainment: serious games aimed at promoting specific learning or compensating learning disorders; games used to collect data and conduct research; and games, whether serious or artistic creations, that raise awareness about specific dynamics and promote more appropriate attitudes. Some companies are now developing specific software for conducting job assessments and facilitating personnel management, such as the Italian startup game2value (https://game2value.it/).

Can video games improve psychological healthcare?

Video games are increasingly being used to achieve specific outcomes, not only in the workplace but also in healthcare. Literature presents cases where video games have been used to facilitate rehabilitation from traumatic brain injuries (Moraes, Zaninotto, Neville, Hayashi & Paiva, 2021), promote training in individuals with ADHD (Evans, Beauchaine, Chronis-Tuscano, Becker, Chacko, Gallagher et al., 2021), and prevent cognitive decline in cases of normal aging and neurodegeneration (Sokolov, Collignon & Bieler-Aeschlimann, 2020).Inizio moduloFine modulo

Already in the middle of the 2010s, a game called Dojo was developed, allowing players to recognize and control their physiological and emotional activations. A Dutch research team, composed of Schuurmans, Nijhof, Vermaes, Engels, and Granic (2015), aimed to study its beneficial effects on a sample of young people hospitalized in two different residential communities for mental health. The video game was specifically formulated to facilitate the psychological processing of one's emotions and perceived physiological activations. Designed to help users

learn relaxation and emotional management techniques, the video game requires players to maintain their heart rate within a predetermined range to prevent the difficulty of each level from becoming so high that it becomes insurmountable. To achieve this goal, participants had to use specific physiological receptors and cognitive-behavioral relaxation techniques.

The study's outcome was positive: a decrease in general anxiety was observed in its participants, young people with psychiatric problems. A very significant finding was the high adherence to the treatment given to the sample. This acquisition is consistent with the initial assumption that the attractiveness of the video game would motivate individuals in the process. This procedure has allowed to the participants to experience complex emotions in a protected context and to generalize these learnings to the external context, through learning specific relaxation techniques via "learning by doing".

While this research provided encouraging data for making video games a usable tool in a psychotherapeutic context, the video game used in this experiment was specifically developed for the occasion. Although the study results are promising, the production costs of such a video game are not accessible to all clinicians. Therefore, one might wonder if the same results can be achieved using commercially available video games.

Commercial video games in clinical use: presenting Video Game Therapy®

The first attempts to use commercial video games in psychotherapy date back to the 1990s, particularly for facilitating the development of a therapeutic alliance with child patients by introducing them to more collaborative goal-setting. Observing their behavior during the game allowed clinicians to infer about the quality of their social interactions (Spence, 1988; Gardner, 1991). It can be asserted that this goal has been clearly achieved by the clinical approach Video Game Therapy®. Created in 2019

by Dr. Francesco Bocci, Video Game Therapy® is a tool inspired by Geek Therapy and classic psychodrama, allowing the integration of the use of commercial video games in psychotherapeutic or clinical psychology settings.

At the core of this approach is the conception of the game as an emotional system that elicits joyful emotions, prompting individuals to exercise their skills to better master certain concrete difficulties and promote interaction with others. This view of the game is derived from the work of Panksepp and Biven (2012): from an evolutionary perspective, playing allows the offspring of a species (including humans) not only to exercise their motor skills and fight or flight reactions, but also promoting joyful social exchanges. Synthesizing the authors, playing is for small children a sort of biological-inducted "training" for further and more complex community interactions.

In more recent times, a structured example of using video games in therapy is proposed by Geek Therapy (Bean, 2018). However, the main working tool of Geek Therapy is not the video game alone, but the protagonist of the patients' favorite geek artifact, extrapolated from anime, manga, comics, LARP (live-action role-playing), pop culture, and among others, video games. Patients' identification with the geek protagonist promotes the expression of certain emotional content, thoughts, and behaviors, thanks to the fictional dimension that suspends judgment from the real world, facilitating the establishment of a protected context in which to express and understand their feelings and experiences (Bean, 2020).

A specific orientation born with the intent of using video games as a key tool in a psychodynamic therapeutic setting is Video Game Therapy®. Created by Dr. Francesco Bocci (Bocci & Sala, 2019; Bocci, 2019; Bocci, Ferrari & Sarini, 2023) as a clinical therapeutic protocol, while clearly inspired by Geek Therapy, this approach aims to use the immersive characteristics of video games to promote emotional containment in patients, in order to set up a therapeutic, supportive-expressive clinical work.

What is Video Game Therapy®?

The uniqueness of Video Game Therapy® lies in enabling the exploration and realization of aspects of oneself in a protected context, the virtual one, where the patient is inherently motivated to progress through the chosen video game and, simultaneously, their therapeutic goals. The video game imaginary context is only partially fictional since it elicits real emotions in real people. The first step involves recognizing these emotions, even the unpleasant ones, and the second is accepting them along with the events that caused them. Some video games assist the user in this emotional containment by replacing unpleasant emotions with something comforting, helping to promote beliefs and attitudes suitable for dealing with complex emotions, much like a caregiver. In this way, video games can be used to explore new emotional management strategies that can be generalized in the real world (Bocci, Ferrari & Sarini, 2023).

According to the principles of Video Game Therapy®, video games offer the possibility to interact in an imaginary scenario, where the patient can express significant aspects of the Self with greater freedom and fewer defenses, thanks to the immersive properties of the video game: a video game, in fact, eases the user to identify his/her-self with the avatar thanks to the particularly attractive experiences it offers. The goal is to make the person reflect on aspects of their personality, identity, emotions, thoughts, and lifestyle.

The Video Game Therapy® approach fits within the context of Adlerian psychodynamic therapy, with clear echoes of the work of Alfred Adler. However, its scientific basis lies in studies demonstrating how the learnings acquired through the use of video games can be transferred even in contexts outside the digital realm. Various examples highlight how video games have positive effects in therapeutic settings. For instance, games like Crash Bandicoot have shown to improve goal planning in children with difficulties following rules at home, while Little Big Planet has facilitated conflict mitigation through discussion, compromise, and adaptation techniques (Al Husni Al Keilani &

Delvenne, 2020). In psychiatric contexts, the use of Tetris in combination with psychotherapeutic approaches has been proven effective in reducing symptoms of PTSD from car accidents or combat (Iyadurai et al., 2018; Butler et al., 2020).

The main features of Video Game Therapy® focus on the relational setting, which refers to the therapeutic alliance between the therapist and the patient, and on the Flow state. The latter is a state of consciousness, proposed by Csikszentmihalyi (1990), where attention is fully focused on the activity, with a distortion of the sense of time and a sense of intrinsic pleasure associated with the activity itself. This psychological state can be activated when a pleasant activity is perceived as adequately challenging, balancing the sense of challenge with personal skills.

Flow is easily experienced in video games, and Video Game Therapy® leverages this characteristic as it allows the player to exercise their skills in a protected context, providing a sense of security. During the Flow state, concentration is so deep that the fear of failure is replaced by the pleasure of doing (McGonigal, 2011). This specific psychological state of Video Game Therapy® allows the player to lower defenses and be more open to self-regulation. While the patient talks, their attention is focused on the enjoyable activity, similar to the EMDR technique, but with the player's attention aimed at success in a pleasant activity (Bocci, Ferrari & Sarini, 2023).

How is Video Game Therapy® structured

Choosing the proper video game

After a careful initial assessment phase, where the patient's personality is defined, and therapeutic goals are agreed upon, a video game in line with the patient's characteristics is identified. This assessment phase is vital to pinpoint the most suitable game, considering the patient's personality and other factors. Subsequently, during the insight phase, the patient fully immerses themselves in an engaging video game, allowing them to

explore a variety of emotions, thoughts, and ideas, even unpleasant ones, experienced at that moment, such as frustration, fear, and sadness. This process promotes understanding, acceptance, and critical reflection on perspectives for change (Ansbacher & Ansbacher, 1956; Ellenberger, 1970; Pagani, 2001).

This recognition can occur with the help of the therapist, although some video games assist the player in making this transition autonomously. This is the case with some horror video games, like Slenderman: The Eight Pages: teenagers who played it constantly scored higher in evaluating and expressing their emotions in relation to the self-compared to those who did not play at all, according to research (Carissoli & Villani, 2019). Additionally, several video games, including Mario Kart and Doom, have been linked to better stress management, adaptive coping, eudaimonic well-being, and socialization skills (Colder Carras, Kalbarczyk, Wells, Banks, Kowert, Gillespie et al., 2018).

Recognizing emotions and thoughts

The insight phase, in which emotional support is provided to help the patient recognize personal themes and complex emotions, is aimed at acknowledging and accepting feelings of inferiority. Another theme inspired by Adlerian principles: the feeling of inferiority is considered common to everyone, a concern for one's own worth that drives people to make compensations, attempts to overcome an initial disadvantage. The goal of Adlerian psychodynamic therapy is to help the person promote compensations for feelings of inferiority, substituting symptomatic compensations with ones beneficial to both oneself and others, with whom one lives interdependently (Ansbacher & Ansbacher, 1956; Ellenberger, 1970; Pagani, 2001).

In Video Game Therapy®, the process of recognizing feelings of inferiority is facilitated by the video game. In fact, every video game puts the player in a position to make mistakes and to consider failure as stimulating. Failure is not conceived as an insurmountable element deflating one's self-esteem but

as a setback that stimulates improvement in performance. This is a significant element in a competitive society where mistakes are not tolerated because they are considered a source of shame (Rothblum, 1990).

Moreover, video games are often designed to induce the player to make a mistake to make the game itself more stimulating. This intrinsic feature in every game can encourage a Video Game Therapy® user to realize that even in the face of defeat, they continue to pursue their goal. The player is guided in a process of constant personal growth until a sense of security and control is developed in the gaming context, which can be generalized to everyday life. Maintaining a sense of competence in a challenging, albeit virtual, environment is crucial for overcoming feelings of inferiority (Bocci, Ferrari & Sarini, 2023).

Shaping a new life style

The understanding of emotions experienced in the therapeutic process and the emerging lifestyle is facilitated for the patient through specific imaginative and storytelling techniques. The former draw inspiration from cognitive-behavioral orientation, while the latter mostly derive from Psychodrama, as conceived by its founder Jacob L. Moreno (Bocci, Ferrari & Sarini, 2023). Despite this convergence of different approaches, the guiding principle of Video Game Therapy® remains the Adlerian psychodynamic model. In accordance with the most traditional psychodynamic models, the function of the therapist is to decode and expliciting the underlying and represented mental content discussed by the patient during Video Game Therapy® sessions.

In the psychodynamic perspective that underlies Video Game Therapy®, great importance is attributed to the therapeutic creative couple: each patient follows a private logic that the therapist understands and is infected by, and then conveys a common logic that is more suitable for addressing vital tasks. The therapist and patient co-construct a new logic that will be more appropriate to guide the lifestyle of the latter. The new logic and the

new lifestyle are generated by a creative couple, which is at the center of Video Game Therapy® (Ansbacher & Ansbacher, 1956; Ellenberger, 1970; Pagani, 2001; Bocci, Ferrari & Sarini, 2023).

Video Game Therapy® is not just a new way to bring commercial video games into a psychotherapeutic context. It is a psychodynamic psychotherapeutic approach that lays its foundations in the Flow experience, wherein emotional containment allows the emergence, discussion, and recognition of previously unknown aspects of the self in the first place. Secondly, video games become the tools for storytelling and re-storytelling the self, with which the patient can conclude not only an insight phase, understanding those unknown aspects of the self but also a reorientation, the development of a new lifestyle (Bocci, Ferrari & Sarini, 2023).

What future for applied games – and for us?

The case of Video Game Therapy® provides numerous stimuli for reflection. Firstly, it is important to recognize that we are dealing with the invention of a psychotherapeutic tool that incorporates various theoretical elements, despite having a clear Adlerian psychodynamic connotation. This result has been achieved thanks to numerous studies that have not exclusively focused on video games' drawbacks, but also on their strengths. Video Game Therapy® is the first attempt to define a psychodynamic protocol for the use of commercial video games in psychotherapy. Bocci's conclusions are valuable not only for clinicians but also for educators: the definition of an emotional containment function of video games, the focus on their encouraging potential based on the suspension of judgment during gaming activities and the state of Flow, as well as the use of video game sessions for storytelling about oneself, are innovative concepts.

One should not consider video games as an exclusive domain for the younger generation; adults and educators should feel justified in becoming intrigued by these passions. Bocci and

Video Game Therapy® deserve credit for emphasizing how video games are a shared dialogue tool among people of different generations. Furthermore, the emphasis on aspects related to flow, suspension of judgment, and the ability to transfer in-game learning to real life suggests that video games can play an important encouraging role. In a strictly Adlerian sense, encouragement is the process that characterizes healthy growth and is at the center of both the therapeutic and educational processes. A mentally healthy person is considered someone with enough courage to face the tasks that life demands; this attitude is usually compromised in cases of mental disorders (Ansbacher & Ansbacher, 1956; Ellenberger, 1970; Pagani, 2001). Video games can be exploited to promote in their users the intention and will to actively immerse themselves in social life – which is the exact opposite of social withdrawal, often characteristic of those suffering from gaming disorder.

The innovative vision proposed by the Video Game Therapy® approach suggests that there is a possibility of nearing to video games differently. Many of the most popular commercially available video games allow for online multiplayer modes, which are increasingly sought after today. Video games are assuming a value not only economically, but also socially. The Video Game Therapy® approach well emphasizes the importance of the Flow state, which also plays a significant role in motivating players to prefer online multiplayer to single-player games, as stated by Hu, Stavropoulos, Anderson, Scerri, and Collard (2019): in their study, those who reported experiencing high levels of online Flow while playing tended to prefer multiplayer video games.

Researchers thus found confirmation of a broad spectrum of literature suggesting that the social component in video games helps maintain high levels of pleasant and immersive experiences. Furthermore, Flow mediated the relationship between preference for online video games and behaviors attributable to video game addiction: high levels of online Flow seemed to mediate a more prolonged, constant, and sought-after use of internet video games, as well as a preference for this type of video game by

users, with elements similar to the proposed online gaming disorder (IGD) in the section dedicated to new studies in DSM-5®.

The research results indicate that Flow motivates online gaming behavior, sometimes intensifying it. In light of the original proposals of the Video Game Therapy® approach, it can be hoped that adults and educators will use the channel of video games as a direct communication tool with their students or children. In this way, they could engage in communicative exchanges on dynamics relevant to the life stages that young people go through, sometimes directly proposed by the narrative content of video games. On other occasions, a video gaming session between mentor and student could become an opportunity to educate about competition expressed in a healthy way.

The video game can present itself as a tool for learning behaviors, attitudes, and skills that will be important in everyday life. In this sense, it can become a means to better express the "onlife" dimension, a term proposed by Luciano Floridi (2015). Where digital and real overlap, educators and developers can work towards positive and encouraging video gaming, in the Adlerian sense of the term described earlier. This is evident in the case of what was observed at the #PLAYSERIOUSLY event, held at the SAE Institute in Milan in the 12th of November, 2022. Participants had to create an inclusive game based on words recognition processes. This video game was requested to be specifically both fun and capable to detect early signs of suspected dyslexia, dysgraphia, or dyscalculia in children aged 5 to 7. The projects presented were very valid and interesting. These projects allowed users to have fun by recognizing letters and numbers without realizing that the activity is designed for their well-being. Perhaps this is the type of gaming to integrate into our habits.

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(Video) playing is a serious thing: a safe social context for edu-activities

by Alessandra Micalizzi

> "It is in playing and only in playing that the individual child or adult is able to be creative and to use the whole personality, and it is only in being creative that the individual discovers the self." (Donald Woods Winnicott, *Playing and Reality)*

Games or applied games? A short excursus among labels

The field of applied games has witnessed a remarkable evolution in recent years and offers a unique approach to address various psychosocial challenges. Applied games, also known as serious games or gamification, involve the use of game elements and mechanics in non-entertainment contexts to achieve specific goals (Fleming et al., 2017). These games have found applications in areas such as education, healthcare, training and psychotherapy, first, in extending the reach of online programmes to those who might not otherwise use them; second, by improving engagement through both game-based and "serious" motivational dynamics; and third, by utilizing varied mechanisms for change, including therapeutic processes and gaming features. In this scoping review, we advance the field by exploring the potential and opportunities available in this area (Connolly et al., 2012)

If we look at the childhood stage, games and stories are two ingredients are essential for the cognitive and socio-relational development of children. In fact, "games and stories are effective: incorporating entertainment elements into training experience, engages and engrosses the learner: the experience is perceived as pleasurable, and they actually spend more time through it, instead of trying to dodge it" (Zungri, 2015, p. 234). In the case of

video games, we can find all of the dimensions that help learning and empowerment, adequately mixed: role-playing, immersion, simulation and story-telling. Of course, these activities are possible in traditional games, too; however digital games, as well as in mediated experiences, have the advantage of engaging multiple senses and providing the opportunity to acquire information and skills in multiple ways. Games stimulate our amygdala. From this perspective, it is interesting to shed light on the fact that an innovative technology excites one of the oldest parts of our brain.

Zungri (2015) has argued that one of the key points of a game experience is to test player adaptation, which is stimulated by the game design and mechanics. Flow is a condition that contributes to experiencing a perfect immersive experience inside the game. The flow state depends on a sense of mastery and accomplishment; it is a crucial part of the sense of presence experienced by players (Diemer et al., 2015). In fact, presence represents the perfect combination among technologies, narratives and psychology, and it is a precondition for having an interactive, immersive experience. Presence is what occurs in the virtual perimeter of a game, whether it is digital or traditional. Three main functions for presence have been recognized. The first is related to the possibility of perceiving oneself in space to direct one's motivation; the second concerns controlling the effectiveness of one's actions through a balance between intentions and results; and the third intercepts the evolution of the self through the identification of optimal experiences called flow experiences (Riva, 2009).

This means that presence is not simply "being in a specific place". To be considered "presence", there needs to be involvement on the perceptual, interpretive and interactive levels, even when we think of physical environments (Micalizzi, Gaggioli, 2018). Sheridan (1992) has identified three factors that can contribute to making this experience intense: the sensory information received from the environment, the ability to control it and the ability to manipulate the physical context. Slater (2009), meanwhile, introduced the dynamicity of the perceptual process

of presence, taking a further step towards what we will shortly call narrative presence. Indeed, Slater distinguishes between place illusion (PI), or the sensation of being in a place, and plausibility illusion (PSI), or the perception that what is in that given place is real.

Gaggioli and Riva (2007) identified a number of factors that can contribute to an optimal interactive experience in technology-mediated contexts: cognitive absorption, understood as the level of concentration on the environment; involvement, which they distinguish into analytical (i.e. rational and conscious) and non-analytical (i.e., centred on a certain transparencies of the technology); and enchantment, understood as the feeling of emotional involvement experienced through the elicitation of awe, curiosity, discovery, aesthetic pleasure and joyfulness. Games, and above all digital games, favour a complete immersion in a new situation that is safe, because it is controlled in all its aspects, and is based on adaptation, in the sense that player could live a progressive degree of difficulty, step by step (Diemer et al., 2015).

Thanks to the versatility of the digital environment, users are projected in situations that could be far from everyday life or simply hard to experience. This is why games are used to simulate situations and to enhance skills and knowledge linked to that specific situation safely. We can imagine how strong these feelings can be for digital natives, who are developing a new mental set of different and new forms of intelligence and skills. If such attributes work for entertainment, the same advantages are also evident in the case of specific skills for learning, development of skills and self-empowering.

The argument in this chapter sees games as natural spaces, anthropologically and almost genetically linked with the evolutionary history of humankind. Games are part of the experience we have to have to grow up and improve our skills. Games have been happening since the beginning of our history. From this perspective, the label "applied game" or "serious game" appears controversial, because it seems to mark the concept that

games – in general – do not have educative effects. However, if we consider the most shareable definition of an applied game, we can find a solution. As argued by Abt (1970), one of the pioneers on this topic, "these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement" (p. 23). From this definition we can at least understand the main points of agreement: educational results are not an effect or a consequence of games but represent their main purpose, and applied games have been a topic in the game studies debate since 1970. Figure 1 illustrates an overview of the main milestones of the debate (Laamarti, Eid, El Saddik, 2014).

Table 1: Milestones in the history of serious games.

Year	Serious game	Application
1970	Serious Games book by C. Abt	Academic book
1972	Magnavox Odyssey	Education
1973	The Oregon Trail	Education
1980	BattleZone	Training
1981	The Bradley Trainer	Training
1982/1983	Pole Position/Atari VCS 2600 console	Training
1996	Marine Doom	Military
2002	America's Army	Military
2003	DARWARS	Military
2005	VBS1	Military
2006	BiLAT	Interpersonal communication
2009	VBS2/Game After Ambush	Military
2012	X-Plane 10	Training

Fig. 1. Main milestones in the serious games debate

Over the last few decades, the market and experiences in applied games have increased, and new labels have been created to focus attention on the specificity of enhancement obtainable by games (Jantke, 2010). One of the most widespread is the one that stresses the role of playing in learning strategies. Prensky (2007), for example, gives a quick and extremely clear definition of digital game–based learning (DGBL) as "any marriage of educational content and computer games" (p. 145).

There are several advantages in using games for learning and educational activities. According to self-determination theory (Ryan, Deci, 2000), playing could reinforce competence, autonomy and relatedness. Moreover, as already stressed, inside the game situation, one can experience the so-called "grateful fail-

ure" (Plass, Homer, Kinzer, 2015, p. 261), which enhances the sense of self-efficacy and motivation (Barz et al., 2023). Barz and his team have conducted a meta-analysis of the most important experiments in applying DGBL with young students and highlighted some consistent aspects that could prove crucial in projecting and designing digital games with specific educational purposes.

First, it is important to pay specific attention to game design. Plass, Homer and Kinzer (2015) proposed a theoretical model called "integrated design framework for playful learning" (Fig. 2) according to which there are four areas that must be considered when we project a game:

- the affective foundation, which is important to engage the player emotively using precise artistic and narrative choices, such as the design of the characters and the use of the music;
- the motivational foundation, which emphasizes the game characteristics to motivate or engage players to play for enjoyment (Barz et al., 2023); self-efficacy, intrinsic motivations and expectation of personal benefits are some of the main motivations that, if stimulated, could increase player engagement;
- the cognitive foundation, which refers to how the information coming from the layers of visual, sound and narrative stimuli of the game are elaborated; players have limited capacity to elaborate information, and for this reason, when designing a DGBL game, it is important to consider a good equilibrium among these three layers of information (Mayer, 2014); and
- finally, the socio-cultural foundation, which deals with the interaction options projected and the (socio-cultural) knowledge required to read and interact with the environment (Plass et al., 2020).

The meta-analysis shows that experiments confirm or confute the use of specific choices in projecting a game. For example, applied games with an educational purpose are more effective if we imagine the repetition of the sessions to scaffold the acquired knowledge (Clark, Tanner-Smith, Killingsworth, 2016). Competition with other players is not necessary to enhance user engage-

ment (Cagiltay, Ozcelik, Ozcelik, 2015); both 2D and 3D games are effective for learning (Ak, Kultu, 2017), but 3D games seem to lead to greater cognitive and affective activation (Lamb et al., 2018). On the other hand, visual realism risks overloading the perception and distressing younger players through cognitive fatigue; for this reason, schematic serious games are more effective (Wouters et al., 2013). If we consider mechanics, studies have shown that using digital agents can help to increase players' motivation and self-efficacy; for example, it seems to be effective for girls' motivation for STEM (van der Meij, van der Meij, Harmsen, 2015). Incentive systems, meanwhile, could trigger extrinsic motivation and influence player behaviour (Kinzer et al., 2012).

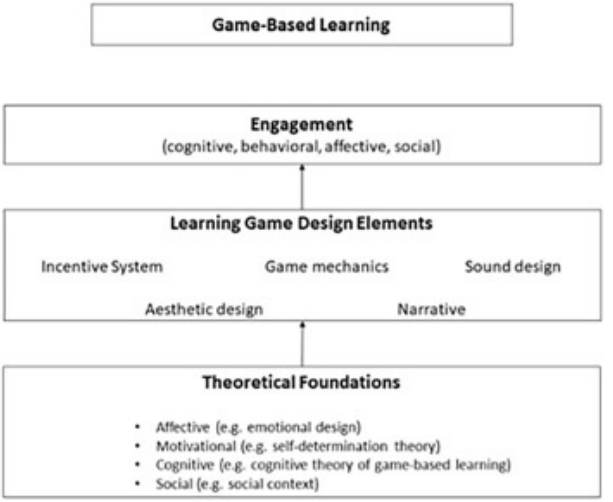

Fig. 2. Integrated design framework for playful learning [source: Barz et al., 2023]

We would like to close this first part of the chapter with a focus on gender differences. We know how long the game industry was inhabited only by men, both as producers and creators as well as players. However, the western market has shown an important inversion of trends, with a substantial parity among female and male players. Inequality continues to be present in

the business sector at all levels, but if we look at the experience in the case of applied games, Vogel et al. (2006) found evidence for gender differences regarding cognitive gains for DGBL interventions; more specifically, female participants "showed significant cognitive gains favoring the interactive simulation and game method" (p. 234).

Pros and cons of applied games: a psychosocial perspective

In the previous pages, we have offered a framework in which we can put applied games. As we have seen, the roots of these specific products can be traced back to the early days of educational simulations and training exercises. In the 20th century, the military and aviation industries started using simulators to train personnel, fostering skill development and risk-free practice. Over the decades – and thanks to improvements in digital technologies – developers, researchers and experts from other sectors (e.g. art, culture, science, education) have recognized the potential of games to engage individuals and promote behaviour change in various domains (among other Viola, 2011; Viola, Cassone, 2017).

However, if there is a strand of studies that highlights the potentiality and strengths of games as a perfect and protected environment for gaining experience and improving skills and knowledge, using applied games is not always possible. It is important to be careful and also consider some limits of this techno-narrative immersive strategy. We have already stressed the advantages in motivation and engagement. This engagement can be leveraged to motivate individuals to address psychosocial challenges, such as anxiety, depression or addiction, by providing a safe and enjoyable environment for personal growth (e.g. Riva, 2009). We have also described the importance of games as a safe place for simulation. This represents an important benefit if we are working with, for example, disadvantaged categories, people with special needs or need to simulate situations that are

not ordinary (Kinzer et al., 2012).

The main application of games deals with the development of specific skills or for educational purposes. Again, we have already specified how they could be valuable when we want to foster the development of various psychosocial skills, including problem-solving, emotional regulation, empathy and communication. These skills can be crucial for enhancing mental well-being and interpersonal relationships (van der Meij, van der Meij, Harmsen, 2015)

However, in operating at the cognitive level as well, games can be useful for changing behaviour. In this case, studies have revealed how rewards, progress tracking and social competition can influence a player's behaviour positively. Recently, the same schema has been applied to applications to encourage users to adopt healthier habits, such as regular exercise or adherence to treatment plans, by making the process more enjoyable and rewarding (Viola, Cassone, 2017). We can consider this to be a playful strategy or a form of gamification.

Looking more closely at the foundations presented above (Fig. 2), the emotional foundation is extremely important, and games show how this is a two-way process. On the one hand, games use narrative, graphic or mechanical strategies to engage the player emotionally. Emotions that a player experiences during the game are crucial for maintaining the experience of flow and for provoking high immersion and engagement. If the player's emotional state can be controlled by the game, this may lead to an increase in the player's attention, interest and sense of satisfaction. (Bontchev, Vassileva, 2015). In this virtual and safe environment, users can find the best place to express and process emotions they might find difficult to convey through traditional methods (Riva et al., 2011).

Finally, we cannot fail to mention the peculiarity of digital games compared to traditional games. Digital games are accessible and playable through devices. The penetration and accessibility of technologies in the population – which are increasingly widespread – contribute to reaching users more quickly and

without forcing them to leave home. This increased reach allows for scalable interventions that can affect large populations, addressing psychosocial issues on a broader scale.

What we have described up to this point stresses the quality and the importance of applied games as a good educational strategy. However, not all of the experiments have been successful. For serious games to serve their purpose, special attention should be paid to the risks of a superficial evaluation of narrative, artistic or design choices during game design and development. We have identified at least four critical points that must be considered if we plan to use applied game strategies in our educational projects. First, the main risk is not engaging the players: if we focus only on the "serious" purposes, we can fail to achieve the goal of engaging the player and supporter his or her enjoyment: applied games cannot omit their playful nature, leaving the educational achievement in the background. This seems to be simple, but it is not, and it requires specific skills in designing and drawing the game. Barz et al. (2023) noted that:

> For a serious game to be successful, an important element is for the game designer to achieve a balance between the fun element and the main purpose of the game which is obviously not entertainment. This means that the entertainment element of the game should not be sacrificed in an attempt to reach the main goal of the game, whether the latter is teaching or improving a health condition and so forth. It may be tempting and even sound logical to give priority to the serious element of the game over the stimulation and engagement that the game is supposed to provide. However, the enjoyment of the game is the very means by which the goal can be reached. Thus, the game, serious as it may be, should be kept enjoyable, or the serious goal would not be reached even though it was given the highest attention in the development of the game. How this balance can be achieved is an area open to research. (p. 12)

Strictly linked to this aspect, we have the risk of unrealistic representation or misrepresentation of the complex psychological issues. If we imagine using applied games for mental health

interventions or rehabilitations – as well as in socio-educational projects – we have to pay particular attention not to perpetuate stereotypes or stress reproduction of unrealistic representations (e.g. Chess, 2020). The debate on this topic remains open, and it is not totally coherent with the purpose of this chapter. In this context we want to stress the risks hidden in underestimating the role of games not only as a media industry but also as a socio-cultural context for constructing and spreading social representation (e.g. Nardone, 2007, 2023).

There are two more risks that can be considered, and both deal with the ethical issues. First, games can lead to excessive use and potential addiction, especially in vulnerable populations. In other words, using games exposes developers the risk of being criticized for pushing users to the behaviours of addiction. The second risk concerns the collection of sensitive data from users. Generally, we are invited when first accessing a game to give our consent to the use our data (about for example the use of a specific platform or game) for statistical purposes. In the case of applied games, these data are extremely valuable to improve the quality of the experience and to highlight the effectiveness of the tool to reach a specific purpose. However, given that applied games deal with sensitive issues (e.g. mental health or weaknesses), ensuring data privacy and consent is essential to maintain trust and protect users' well-being.

We can thus say that applied games have come a long way from their early roots as training simulations and have evolved into powerful tools with significant potential for addressing psychosocial challenges. Their engaging nature, ability to promote behaviour change and accessibility make them valuable assets in various domains. However, developers and researchers must remain mindful of the risks associated with applied games, such as potential addiction and the oversimplification of complex issues. By striking a balance between entertainment and meaningful impact, leveraging personalization and maintaining ethical considerations, applied games can continue to evolve as potent allies in the pursuit of improved psychosocial well-being. Their

integration with evidence-based practices and ongoing research will further solidify their place as valuable tools for addressing psychosocial issues in the future.

Barz et al. (2023) developed a model based on six critical factors that will be key in accelerating the movement of serious games towards mass adoption. More specifically, the team highlighted the importance of:

- user-centred software engineering;
- multimodal serious games: in order for a game in general and a serious game in particular to be convincing to the user, multiple modalities should be incorporated, even if developers have to consider the risk of distracting the attention by the users and a consequent drop in performance;
- social well-being: applied games have to stimulate a feeling of virtual presence or connectedness that can contribute to social well-being in real life;
- adaptive gaming: a serious game should adapt to a particular player's capabilities, needs and interests;
- standardization of evaluation, which means that performance metrics define how serious games are evaluated is welcomed by the research community; and
- sensory-based simulations, with the main purpose of accurately reconstructing real world scenes; to get to this point, methods and techniques require real world data.

Screening dyslexia: definition and assessment tools

Starting from these premises, considering the pros and cons, in the next page we propose a reflection on the fact that applied games could be an option for the screening of specific learning disorders (SLDs) with a special focus on dyslexia. So what are SLDs and what is dyslexia exactly?

> Learning disabilities, or learning disorders, are an umbrella term for a wide variety of learning problems. A learning disability is not a problem with intelligence or motivation…. Simply put,

> children and adults with learning disabilities see, hear, and understand things differently. This can lead to trouble with learning new information and skills and putting them to use. The most common types of learning disabilities involve problems with reading, writing, math, reasoning, listening, and speaking. (Help Guide, 2012)

Children with SLDs face unique challenges in traditional educational settings. These disorders – which include dyslexia, dysgraphia, and attention-deficit/hyperactivity disorder (ADHD) – can significantly affect a child's ability to learn, retain information and perform academically (see Fig. 3). Dyslexia is an SLD that affects reading, spelling and writing skills. It can be defined as an unexpected difficulty in reading in relation to cognitive ability, education or professional status (e.g. Lyon, 1995; Lyon, Shaywitz, Shaywitz, 2003). The European Dyslexia Association estimates that between 5% and 12% of the population of Europe is dyslexic; however, the data are extremely heterogeneous around Europe. In fact, rates of dyslexia range by country from Iceland at nearly 24%, to Sweden at less than 3%, with 31 countries represented, most of which register around the 5% mark (Dyslexia Compass, 2021). In Italy, the percentage of students with SLDs stands at 5.6%, among which 2.8% are dyslexics (MIUR, 2021). Considering students that have not yet received a diagnosis and others that have special needs that are not better defined, the percentage of students asking for support and needing to develop compensatory strategies in reading and writing skills is surely greater.

Early diagnosis of dyslexia is crucial for timely intervention and support to help affected individuals overcome their challenges and reach their full potential. Over the years, advances in research, technology and educational practices have significantly improved the state of early diagnosis in dyslexia. However, there are still some issues affecting early diagnosis. First is the age of acquisition of the specific skills observed for the diagnosis. In Italy, as well as in most European countries, pupils start to approach academic programmes that include reading

and writing skills at the age of six; but only at the end of the second grade (age seven) is it possible to consider those skills opportunely absorbed. For this reason, it is not possible to make a correct assessment before that age. Moreover, other contextual factors – such as socio-cultural situations, parenting, knowledge of the language, schooling of the family and of the children – that can represent risks factors in the acquisition of skills, hiding real disorders or, on the contrary, favouring an overlap between SLDs and so-called special educational needs.

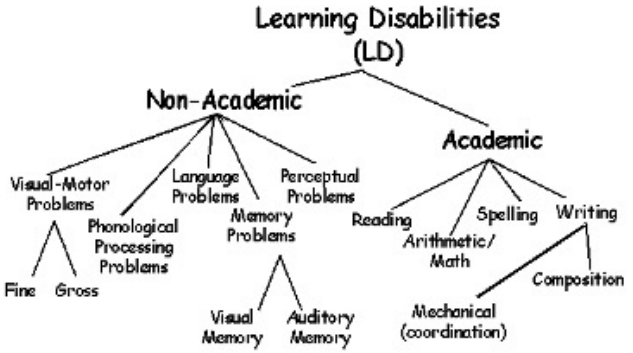

Fig. 3. Schema of specific learning disorders

Effective early detection of dyslexia begins with screening methods that can identify potential risk factors and warning signs. These methods are often employed in educational settings, such as preschools and elementary schools, to identify children who may require further evaluation and support. The diagnosis is a complex process that includes more than one tool, and it is not a one-shot interview, but includes more than one praxis. The following methods are the most effective, especially when combined.

- *Phonological awareness assessments*: Phonological awareness is the ability to recognize and manipulate the sounds of spoken language. Screening tests evaluate a child's phonemic awareness, phonological memory and rhyming skills, which are essential components of reading development.

- *Rapid automatized naming (RAN) tests*: RAN tests assess a child's ability to name a series of familiar objects, letters or colours quickly. Poor performance on RAN tests is associated with dyslexia and may indicate difficulties in the retrieval of phonological information.

- *Family history and observations*: Family history can be a significant indicator of dyslexia, as the disorder often runs in families. Teachers and parents may also observe difficulties in letter and word recognition, reading fluency and spelling, prompting further evaluation.

- *Pre-reading assessments*: Early pre-reading assessments can identify potential risk factors for dyslexia before formal reading instruction begins. These assessments may involve tasks that assess a child's ability to recognize letters, associate them with sounds and understand basic concepts of print.

After initial screening, comprehensive assessments are conducted by specialized professionals (e.g. educational psychologists, speech-language pathologists and reading specialists) to confirm the presence of dyslexia and determine its severity. Various assessment tools are used to provide a detailed understanding of the individual's strengths and weaknesses in reading and related skills, such as the common tools listed below.

- *Reading and decoding assessments:* These assessments evaluate a child's reading accuracy, fluency and comprehension. They identify specific areas of reading difficulty, such as word recognition, decoding and reading speed.

- *Spelling and writing assessments:* These assessments explore a child's spelling abilities and written expression. Difficulties in spelling and written communication are often associated with dyslexia.

- *Cognitive and language assessments:* Assessments of cognitive abilities, such as working memory, attention and processing speed, provide insights into the underlying cognitive processes that may contribute to dyslexia.

- *Visual and auditory processing assessments:* Visual and auditory processing skills are assessed to determine if any sensory processing deficits are contributing to reading difficulties.

3.1 Why early diagnosis is effective

An early diagnosis of dyslexia is significant for children's well-being, and it should be based on the age, characteristics and specific situation of the individual. Early diagnosis represents the right approach to prevent the frustration and negative feelings experienced in educative contests and in relation to the peer group. However, it cannot be taken for granted. Early diagnosis requires a collaborative approach among the school, educators and care givers, who should have an open channel of communication and monitoring of the child's behaviour. It is also important to share awareness about the first signals that may indicate possible difficulties or disabilities in learning skills.

More specifically, we can identify at least five reasons to encourage an early diagnosis. First, early identification allows educators and specialists to provide targeted and individualized interventions to address the specific needs of children with dyslexia. Second, programming tailored support can contribute to prevent academic gaps from widening, thus enabling children to keep up with their peers in reading and writing skills. Third, the impact of good experiences at school in boosting confidence and self-esteem in children cannot be underestimated, especially in the first stage of their growth. It creates a positive spiral building a solid motivation for future learning activities (García-Redondo et al., 2019). Fourth, early intervention often focuses on developing phonological awareness skills, which serve as building blocks for reading and writing. Finally, an early diagnosis considerably reduces emotional distress. In fact, children with undiagnosed dyslexia may experience emotional stress and frustration due to academic struggles. Early diagnosis and support can reduce this stress and create a positive learning environment, favouring inclusion and peer-to-peer relations in the classroom (Yim, Graham, 2007).

The role of applied games in supporting children with SLDs

In the previous section, we stressed the importance of an early diagnosis. However, despite significant progress in the development tools and assessment, some challenges remain open and intervene in the push to find other solutions. As we have emphasized in other parts of this chapter, awareness among educators and parents about dyslexia and its early signs remains generally low. This leads to a delay in diagnosis and intervention. In addition, in some countries, a dyslexia assessment will not be considered "official" in the sense of being standardized and officially accepted for designing personalized learning plans (Dyslexia Compass, 2021). This is not the case of Italy where the equipment and the assessment tools are specified in the official rules at the national and regional level. This means that, in Italy at least, educators and teachers have clear procedures to follow to ensure a good learning experience for their pupils. Another problem remains prevalent in Italy, however, as serious difficulties are registered among people who need access to specialized assessment and intervention services, which can be limited to certain regions. This causes delays in diagnosis and timely support. To cope with this long-standing problem, educators and teachers need to evaluate the possible risk of dyslexia using other tools. The Annual Report of Dyslexia in Italy (2022) sheds light on the fact that this strategy is not totally effective. In fact, only 0.12% of pupils at risk of dyslexia are intercepted by observations and other assessment tools.

Despite efforts to ensure early diagnosis, the average age at which children receive learning disabilities assessments is nine years (Shaywitz, 1998; Kokkalia, Drigas, Economou, 2016). This also depends on another aspect that contrasts with an early diagnosis: dyslexia presents differently in different individuals, and its assessment can be complex, requiring a comprehensive understanding of the unique strengths and weaknesses of each child. Diagnosis can also be more complicated when other health or developmental conditions are also present. Educator and cli-

nicians are asked to find out if a reading difficulty is the result of dyslexia or some other condition that changes how the brain works. Around 60% of pupils with dyslexia have at least one other diagnosis (Darweesh et al., 2020), and researchers have found that conditions co-occur because of the specific way biological, environmental and protective factors interact in people's bodies and in their lives (Moll, Snowling, Hulme, 2020). Ongoing research is essential to identify new screening methods, assessment tools and intervention strategies that can further improve the state of early dyslexia diagnosis. Advances in technology have opened up new ways to support these children's educational journey through applied games. This chapter explores how applied games can be used as an effective tool to enhance learning experiences for children with SLDs, fostering their academic progress and overall well-being.

Videogames offer several advantages for supporting children with SLDs. Scholars have argued that games – not just those with an educative purpose – can be extremely effective in pre-school activities to support children who face literature, math, cognitive, intellectual and physical difficulties. The same results are also obtained in case of children who are gifted or face developmental disorders such as autism (Hutinger et al., 2006; Gaggi et al., 2012; Kokkali, Drigas, Economou, 2016). One of the most significant benefits of applied games is the ability to customize the learning experience for each child. The games can be adapted to a child's skill level, pace and learning style, providing personalized challenges and support as needed. Moreover, many children with SLDs respond well to multi-sensory learning approaches. Applied games often incorporate visual, auditory and kinaesthetic elements, thus engaging multiple senses simultaneously to reinforce learning (Fleming et al., 2016). Applied games can provide immediate feedback on a child's performance, enabling them to recognize and correct errors in real-time. Positive reinforcement through rewards and progress tracking can also boost a child's confidence and motivation to learn.

In the evaluation of applied games in assessment and treat-

ment, we also have to consider the reduced stigmatization, thanks to the safe and protected environment of the experience. Traditional classroom settings may sometimes lead to stigmatization and a sense of inadequacy among children with SLDs. Applied games offer a safe and non-judgmental space for learning, thus reducing the emotional burden associated with academic challenges (Gaggi et al., 2012, 2015). By integrating game mechanics such as challenges, levels and rewards, applied games make the learning process more enjoyable and engaging. This gamification aspect can inspire children to stay focused and invested in their educational journey (Bakar, ChePa, Sie-Yi, 2023). Finally, applied games are inherently engaging, attracting users' attention and sustaining their interest. This engagement can be leveraged to motivate individuals to address psychosocial challenges such as anxiety, depression or addiction by providing a safe and enjoyable environment for personal growth. For example, García-Redondo et al. (2019) showed how the use of games can improve the attention of students with learning disabilities.

Beyond applied games: the role of new technologies, immersive approaches and AI in screening, diagnosis and rehabilitation of dyslexia

The Play Seriously project, promoted by SAE Institute of Milan with the support of other five universities located in the South East of Europe, aimed to develop an applied game for screening dyslexia indicators in children aged 5–7 years. This means that the project can be framed in the background described above and has tried to consider all of the aspects, limits and opportunities in projecting, developing and designing the game. Advances in technology have opened up exciting possibilities for enhancing dyslexia screening, diagnosis and rehabilitation processes. For this reason, to conclude our short chapter, we explore some of the main frontiers and trends concerning the role of new technologies, immersive approaches and artificial intelligence (AI)

in addressing dyslexia, with a focus on early intervention and personalized support.

Some of these newly developed products target screening, while others support the improvement of skills. The advantages of using new technologies are clear and have been discussed in the previous sections. Digital environments offer a familiar context to children, help with remote monitoring, reduce emotive reactions and track progressions, contributing to forward steps in research in this field. If more and more games, apps and other new tools are developed and applied, other technologies can also make a difference, even if they are currently less "mainstream", and be applied in screening and supporting children with specific learning disorders. These could include the following tools:

- *Eye-tracking technology:* Eye-tracking technology allows researchers and clinicians to study how individuals with dyslexia process visual information during reading. This technology can aid in the early identification of eye movement patterns that are characteristic of dyslexia, which could contribute to more precise and early diagnosis.

- *Machine learning and data analytics:* Utilizing machine learning algorithms and data analytics, researchers can analyse vast amounts of data from dyslexic individuals to identify patterns and risk factors associated with the disorder. This could help in refining dyslexia screening tools and clarifying the heterogeneity of dyslexia presentations.

- *Virtual reality (VR):* VR allows for interactive and immersive reading and writing tasks that simulate real-life challenges faced by dyslexic individuals. VR-based assessments can capture a more comprehensive picture of a child's reading capabilities in a controlled and engaging environment.

- *Augmented reality (AR):* AR interventions integrate virtual content into the real-world context, offering dyslexic learners personalized support and feedback. For example, AR applications can provide real-time spelling assistance and pronunciation guidance during reading practice.

In particular, research could pursue a specific focus on the application of AI in diagnosis and support. AI and machine learning have transformative potential in the field of dyslexia, enabling early diagnosis, personalized intervention and continuous progress monitoring (Drigas, Ioannidou, 2013). In addition, AI-powered algorithms can analyse data from multiple sources – such as reading tests, eye-tracking measurements and cognitive assessments – to detect patterns indicative of dyslexia. Automated screening would expedite the identification of at-risk individuals (Poornappriya et al., 2020). One of the most relevant qualities of AI for this application is its high level of personalization, which would be effective in case of learning paths. Indeed, AI can analyse individual learning profiles and adapt instructional content to suit each learner's strengths and weaknesses. Personalized learning paths allow dyslexic individuals to receive targeted support that aligns with their specific needs and learning styles. Finally, strictly linked to the use of AI, are tools that use natural language processing (NLP). These could be used for dyslexia assessment. Indeed, NLP techniques can help analyse written language samples to identify spelling errors, grammar mistakes and areas of difficulty in reading and writing. NLP-based assessment tools would offer a non-intrusive way to monitor progress over time.

The integration of new technologies, immersive approaches and AI in dyslexia screening, diagnosis and rehabilitation opens up exciting possibilities for early identification, personalized intervention and continuous progress monitoring. These advances offer hope for a more inclusive and supportive educational landscape that would empower dyslexic individuals to overcome challenges and achieve their full potential. As technology continues to evolve, it will undoubtedly play an increasingly significant role in shaping the future of dyslexia interventions and improving outcomes for those affected by this SLD.

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Dyslexia, early indicators and screening
Testing like playing

by Sara Zaccaria

Developmental dyslexia is a specific deficit in reading that cannot be accounted for by low IQ, poor educational opportunities or obvious sensory or neurological damage (World Health Organization, 2008). It has been estimated that dyslexia affects about 3-7% of the population (Lindgren, De Renzi e Richman, 1985), but the actual incidence could be slightly variable from language to language. Dyslexia is predominantly characterized by a core deficit in phonological processing (the ability to recognize and manipulate speech sounds), which results in impairments in decoding ("sounding out" words), spelling, and word recognition (Vellutino, Fletcher, Snowling & Scanlon, 2004).

Research has made tremendous progress in specifying biological and environmental factors associated with this disorder. A central environmental factor that has been identified to influence reading acquisition and dyslexia is the particular orthography that the child is acquiring. All orthographies depict the sound structure of the language they represent, but there is considerable variability in how transparent this relationship is for the learner and how consistently orthographic symbols represent the sounds of a particular language. Both theoretical conceptions (Katz & Frost, 1992; Ziegler & Goswami, 2005) and empirical evidence suggest that transparent orthographies with high symbol-sound consistency are acquired more easily than complex and opaque orthographies with a high proportion of inconsistent and irregular spellings.

In DSM-5 (American Psychiatric Association, 2013), dyslexia is classified with other neurodevelopmental disorders which have early onset, under the collective name of Specific Learning

Disorders. These disorders have a biological origin that underlies the abnormalities at cognitive level that are associated with the behavioral symptoms and includes an interplay of genetic, epigenetic and environmental factors that affect the brain's ability to perceive or process verbal or non-verbal information efficiently and accurately (DSM-5).

Specific Learning Disorders are related to school skills and specific about the area of impairment. They affect reading, writing and calculation in selective ways.

The term *dyslexia* refers to the specific reading disorder, which concerns decoding words, in regard to speed and correctness parameters. Formally, a diagnosis of dyslexia cannot be made until the child has completed the second year of primary school. This timeframe makes it possible to ensure that the child has completed the formal period of reading-writing instruction and thus to exclude the possibility that the detected difficulties can be attributed to a situation of lack of learning.

Dyslexic children may read very slowly but be accurate, they may read fluently but make a lot of mistakes in decoding words. It is also possible for dyslexia to affect fluency and accuracy at the same time. Errors in reading can lead to poor comprehension of written texts, even if comprehension is not the core deficit of the disorder.

Epidemiological surveys estimate that in Italy there are approximately 350.000 children, adolescents and adults with learning disabilities or specific learning disorders, a considerable number that accounts for the ever-increasing interest in the issue in the clinical and educational spheres.

Data collected in Italy form Ministero dell'Istruzione (MIUR, 2022) on the school population in the years 2020-2021 reports and incidence of children with learning disabilities between 2.97 and 3.43 in primary school an 6.12-8.92 for secondary school. Considering the different typologies of disabilities in the learning areas, from the sample of schoolchildren mentioned above, 198.128 had a diagnosis of dyslexia, 99.769 had a diagnosis of writing disorder on the graphomotor side and 117.849 on the orthographic

side, and finally 108.577 were identified as dyscalculic.

Dyslexia, as well as other learning disorders, is a clinical condition that has important repercussions on a child's well-being and adaptation at school. Experiences of school failure can generate emotional consequences.

Dyslexia is also often associated with other clinical conditions. Approximately one-half of children identified with dyslexia have language disorders, and approximately one-half of children with language disorders have dyslexia (Adolf &Hogan, 2018). Dyslexia typically results from a core deficit in phonological processing; however, it is important to note that language deficits (e.g., low vocabulary or low oral listening comprehension) can also lead to reading problems, especially problems with reading comprehension. Importantly, speech and language problems commonly precede problems in learning to read, so children with these specific difficulties should be flagged as being at increased risk for dyslexia (Cabbage, Farquharson, Iuzzini-Siegel, Zuk & Hogan (2018).

There are many other developmental and psychiatric conditions that are often comorbid with dyslexia, further jeopardising the health and academic outcomes of these children. Overall, 20% to 40% of children with attention-deficit/hyperactivity disorder have dyslexia (Germanò, Gagliano &Curatolo, 2010), and children with autism spectrum disorder are also at increased risk of dyslexia (Asberg, Kopp, Berg-Kelly &Gillberg, 2010). Other behavioural disorders, such as conduct disorder and oppositional defiant disorder, are also associated with dyslexia (Burke, Loeber & Birmaher, 2002). Up to 85% of children with dyspraxia (a developmental coordination disorder) have dyslexia (Pauc, 2005), and children with dyscalculia (a maths learning disability) (Moll, Landerl, Snowling & Schulte-Körne, 2019) and dysgraphia (a print learning disability) (Döhla & Heim, 2016) are more likely to have dyslexia than those who do not.

Etiology of dyslexia

As already mentioned above, the etiology of dyslexia is multifaceted, including genetic, perceptual and cognitive, neurobiological, and environmental factors (Ozernov-Palchik, Yu, Wang & Gaab, 2016). Dyslexia is strongly heritable, occurring in up to 68% of identical twins of individuals with dyslexia and up to 50% of individuals who have a first-degree relative with dyslexia (Snowling & Melby-Lervåg, 2016; Grigorenko, 2009). Several genes have been reported to be candidates for dyslexia susceptibility (Galaburda, LoTurco, Ramus, Fitch & Rosen, 2006; Mascheretti, De Luca, Trezzi, et al., 2017); it is thought that most of these genes play a role in early brain development (Galaburda, LoTurco, Ramus, Fitch & Rosen, 2006; Mascheretti, De Luca, Trezzi, et al., 2017; Skiba, Landi, Wagner & Grigorenko, 2011).

Recent studies have consistently shown (Frisk, 1999) that dyslexia is regarded as a genetic neurological disorder. According to researches, three candidate genes predisposing to dyslexia are located within chromosome 6 and chromosome 15 (Grigorenko, Wood, Meyer, Hart, Speed, Shuster & Pauls, 1997), which influence the storage processing of visual verbal stimuli—in mainly the short-term memory, the reading ability, and partly the phonological awareness and verbal recognition skills (Gayán, Smith, Cherny, Cardon, Fulker, Brower et al., 1999; Nopola-Hemmi, Taipale, Haltia, Lehesjoki, Voutilainen & Kere, 2000).

It is widely believed (Augustyniak, Cook-Cottone & Calabrese, 2004; Bialystok, 1991; Carroll, Snowling, Stevenson & Hulme, 2003; Nicolson, Fawcett, Berry, Jenkins, Dean & Brooks, 1999; Snowling, Bishop & Stothard, 2000) that children with dyslexia suffer from an early deficit in their phonological skills which deters them from the standard acquisition of reading and writing skills.

In addition, several studies have shown atypical brain characteristics in individuals with dyslexia compared to their peers (Richlan, Kronbichler & Wimmer, 2011). In functional MRI studies, researchers have shown that reading in typical readers

takes place predominantly in left-hemisphere areas of the brain, including the inferior frontal, superior temporal, temporoparietal and occipitotemporal cortices (Martin, Schurz, Kronbichler & Richlan, 2015). As a group, individuals with dyslexia show hypoactivation in left hemisphere reading systems (Peterson & Pennington, 2012). Structural and functional atypicalities in these brain regions include reduced grey matter volume (Linkersdörfer, Lonnemann, Lindberg, Hasselhorn & Fiebach, 2012), hypoactivation in response to reading-related functional MRI tasks (Richlan, Kronbichler & Wimmer, 2009), and weaker functional connectivity between key areas of the reading network. Importantly, differences in brain structure and function characteristic of dyslexia can be observed before the onset of formal reading instruction, suggesting that dyslexia does not result from a struggle in learning to read, but rather represents a biological predisposition that is present at preschool age, or perhaps as early as infancy (Langer, Peysakhovich, Zuk, Drottar, Sliva, Smith, Becker, Grant & Gaab, 2017; Leppänen, Hämäläinen, Guttorm, Eklund, Salminen, Tanskanen et al., 2012; Im, Raschle, Smith, Ellen Grant & Gaab, 2016). Taken together, these neuroimaging findings suggest that children predisposed to dyslexia enter their first day of school with brains that are less equipped to learn to read.

Early identification

Although neuroimaging research has been of extreme importance in establishing the biological basis of dyslexia and reading impairments, neuroimaging technology (e.g., brain MRI) does not have the ability to screen or diagnose dyslexia on an individual level. Neuroimaging is not yet able to clearly disentangle differential neurobiological effects of dyslexia versus other reading impairments (Richlan, Kronbichler & Wimmer, 2011; Noble, Wolmetz, Ochs, Farah & McCandliss, 2006). For these reasons and many others, cognitive-behavioral strategies are much more useful in screening.

As children progress through the school system, reading becomes the expected tool for content learning, so it is imperative those with dyslexia are identified early and receive intervention without delay. When at-risk beginning readers receive intensive early reading intervention, 56% to 92% of these children achieve average reading skills (Torgesen, 2004). In fact, it is actually noted that if children with dyslexia attend reeducation programs from preschool or the first year of primary school, they exhibit a better development, since the intervention time demands shorter duration. It is actually reported (Eden e Moats, 2002), that intervention at these specific stages produces better results and contributes to the decrease of emotional disorders in comparison with the application of intervention programs later on (form third grade of primary school and on).

They also claim that the early detection of dyslexia during the preschool age (5-7 years old) can initiate positive "changes" in the function of the plastic cerebrum, which in turn may enable these children to reach the skills of an average, normal child (Kujala, Karma, Ceponiene, Belitz, Turkkila, Tervaniemi & Näätänen, 2001; Temple, Deutsch, Poldrack, Miller, Tallal, Merzenich & Gabrieli, 2003; Torgesen, Alexander, Wagner, Rashotte, Voeller & Conway, 2001).

However, many children are diagnosed with dyslexia long after they first demonstrate recognizable difficulties with pre-literacy milestones (Torgesen, 2002). Currently, children are typically diagnosed with dyslexia in late second or early third grade (and many much later), after they have failed to learn to read for an extended period of time and have fallen academically behind their peers (Wanzek & Vaughn, 2007). This approach of waiting for failure before addressing for an assessment for possible specific disorders fails to capitalize on the most effective window for intervention, which is during an earlier period of increased brain plasticity in kindergarten and first grade (Wanzek & Vaughn, 2007; Fox, Levitt & Nelson III, 2010).

Children with untreated or undiagnosed dyslexia are exposed to a prolonged period of failure that can have serious implica-

tions for their mental health. Often perceived as lazy or labelled as "not intelligent", children with dyslexia can develop low self-esteem, which can lead to anxiety and depression (Mugnaini, Lassi, La Malfa & Albertini, 2009). In addition, children with learning difficulties are less likely to complete high school (Jimerson, Egeland, Sroufe & Carlson, 2000), and less likely to enroll in higher education programs (Dougherty, 2003). Given the prognostic benefit of early diagnosis and intervention, and the many adverse outcomes that can be avoided or mitigated, there is great value in identifying early risk for dyslexia.

During preschool years, specific developmental dyslexia (Lishman, 2003) is characterized by slow progress: (i) in development and production of phonological codes and process of language stimuli (deficiency in auditory perception and discrimination of phonemes), phoneme-grapheme correspondence, semantic acknowledgment of words and nonwords (Ball and Blachman, 1991; Elbro, Borstrøm & Petersen, 1998), (ii) in psychomotor development: cross-dominance (Helland & Asbjørnsen, 2001), left–right discrimination, grapho-motor ability (Devillaine, Lambert, Boutet, Aloui, Brault, Jolly & Labyt, 2021), body shape, spatio-temporal orientation (Marendaz, Valdois & Walch, 1996) and visual-motor processing (Chase, 1996; Slaghuis & Ryan, 1999), (iii) in development of neural and cognitive mechanisms such as memory (short-term memory), visual and auditory perception, selective attention (Näätänen, 1990; Share & Stanovich, 1995).

Looking at the incidence in the Italian school population, the same survey conducted by Ministero dell'Istruzione (MIUR, 2022) shows that the number of preschool children with some signs of potential Specific Learning Disabilities was 1.752 for the 2019-2020 school year and 1.391 for the 2020-2021 school year. The number of children in the first two years of primary school with symptoms associated with dyslexia was 3.820 in 2019-2020 and 3.700 in 2020-2021. These figures show that there is evidence to support the early identification of children who may develop Specific Learning Difficulties during their school career and who

can be supported in the early stages of their learning journey.

Studies of the variations in reading skills in unselected samples of children typically begin when children are in the year prior to school entry. Those which have been conducted in alphabetic languages converge on the view that there are three predictors of individual differences in children's decoding, word recognition skills, and reading fluency: letter knowledge, phoneme awareness, and rapid automatized naming (RAN) (e.g., Caravolas, Lervåg, Mousikou, Efrim, Litavsky, Onochie-Quintanilla et al., 2012). Less attention has been paid to the precursors of these crucial foundations (e.g., Carroll, Snowling, Hulme & Stevenson, 2003). However, two large scale studies following children from age three reported that early language skills predicted individual differences in phonological awareness and letter knowledge which, in turn, predicted reading (NICHD, 2005; Storch & Whitehurst, 2002); this study also reported a direct effect of language on later word decoding. It follows that oral language difficulties beyond specific phonological processes may be additional risk factors for dyslexia. Consistent with this, children with specific language impairment are at high risk of dyslexia (Bishop & Snowling, 2004).

An important research question that arises from the well-documented orthographic differences in early and deficient written language processing is to what extent the cognitive mechanisms underlying reading acquisition and dyslexia might vary as well. English-based research has identified verbal-phonological processing as the central cognitive predictor of typical as well as dyslexic reading development (Vellutino, Fletcher, Snowling & Scanlon, 2004), but there have been claims that focusing on the complex English orthography may have led to an overestimation of the relevance of phonological processing (Share, 2008). In transparent orthographies, even children who start reading acquisition with deficient phonological skills may be able to understand the mappings between spoken and written language if they are simple enough. Moreover, a simple and transparent representation of the phonological structure may help children to

overcome early deficits, even more so if formal reading instruction is strongly phonics-based as is the case in many consistent orthographies.

Recently, a number of large-scale cross-linguistic studies of typical reading acquisition in different orthographies have addressed this issue. While this approach cannot eliminate all the methodological problems inherent in comparisons across different educational, cultural and linguistic backgrounds, the results are easier to interpret within such designs than between studies conducted independently in different orthographic systems. Ziegler et al. (Ziegler, Bertrand, Tóth, Csépe, Reis, Faísca et al., 2010) studied 1263 second graders in five orthographies of increasing complexity (Finnish, Hungarian, Dutch, Portuguese, French) and indeed found support for the hypothesis that phonology may be less relevant in consistent orthographies, as the effect of phonological awareness (PA) was weaker. Nevertheless, PA was significantly associated with reading accuracy and speed in all orthographies and was the strongest concurrent predictor in all orthographies except the highly transparent Finnish writing system, where vocabulary was the strongest predictor of word reading speed and predicted reading accuracy as strongly as phoneme deletion. Another well-established predictor of reading, rapid automated naming (RAN, see Kirby, Georgiou, Martinussen, & Parrila, 2010 for a recent review), did not show marked differences across orthographies and overall showed surprisingly moderate associations with reading. Two reasons may explain this atypically low relationship between RAN and reading. First, Ziegler et al. (2010) used sequential naming of pictured objects, and there is evidence that alphanumeric RAN tasks (letters, digits) show a stronger relationship with reading than such non-alphanumeric versions (e.g., Bowey, McGuigan & Ruschena, 2005).

Second, the strength of the RAN-reading association may be relatively weak among Ziegler et al.'s sample of young readers and may increase later in reading development. This is suggested by another recent cross-language study by Vaessen et al. (Vaes-

sen, Bertrand, Tóth, Csépe, Faísca, Reis & Blomert, 2010) which focused on the concurrent prediction of reading fluency in three orthographies with increasing complexity (Hungarian, Dutch, Portuguese). Findings indicated a shift of cognitive mechanisms underlying reading fluency during development. In Grades 1 and 2, the association of PA and RAN (objects, letters and digits combined) with reading fluency was largely comparable, while in Grades 3 and 4, RAN was more strongly associated with reading fluency than PA. Importantly, Vaessen et al. (2010) confirmed that cognitive mechanisms underlying reading were similar across the three alphabetic orthographies, but again, the association of reading with PA, but not with RAN or verbal short-term memory, was modulated by orthographic complexity.

Risk indicators for Specific Learning Disorders on Italian language

More and more attention has been paid to SLDs (Specific Learning Disorders) and associated disorders, as more and more evidence shows how these neurobiologically-originated difficulties can hinder the natural course of school learning.

Many studies have focused on analyzing whether and what are the early indicators of the later development of ASD, but while there is now a great deal of knowledge on the subject, it is equally clear that there are no single indicators that can predict with certainty who will develop the disorder. The most recent indications seem to suggest that the co-occurrence of multiple difficulties increases the percentage of risk, but each factor and combination of factors can only predict a modest percentage of future development.

The presence of a Specific Learning Disorder can be a causal factor not only for the development of difficulties at school, but also for distress in the emotional-relational sphere. If not promptly identified and treated, the disorder can alter the child's perception of his or her competence, with significant consequences

in the maintenance of emotional-motivational balance.

Recent research, within the national and international literature, underlines the possibility and necessity of conducting assessments on what can be defined as basic reading-writing skills and competences, in order to prevent and monitor possible forms of difficulty.

What seems the best course of action is working from preschool on the early identification of difficulties in the functions that form the basis of subsequent learning, while at the same time implementing targeted reinforcement actions.

The scientific literature agrees on some specific abilities as important predictors of later school learning, together with significant indicators of possible language disorders. As mentioned above, there are some differences between the acquisition process of transparent and non-transparent language. Italian is one of the transparent languages and is consequently based on the direct correspondence between phonemes and graphemes. For this reason, the most important early skills associated with learning to read and write are the same: metaphonological awareness, letter recognition, vocabulary, morphosyntactic comprehension and phonological memory. These skills can be easily observed and measured in preschool children in order to identify those who are at risk of developing learning difficulties or learning disabilities in the years to come, and to propose activities designed to promote the acquisition of such skills.

Metaphonological awareness

A large body of research has shown that phonological skills can be considered among the best predictors of subsequent reading learning (Goswami & Bryant 1990; Rack, Hulme, Snowling & Wightman, 1994; Wagner & Torgesen, 1987).

Phonological awareness is a particular form of phonological competence, considered central to reading acquisition, which can be defined as the ability to identify the phonological components of speech such as syllables and phonemes in a phonological continuum, and to be able to intentionally manipulate them.

Phonological awareness is structured according to different levels that reflect the competence of the subject in action. Morais (1991) proposed the distinction between global and analytical phonological awareness. The former develops from the age of 3-4 years, independently of learning the written language, and implies the ability to perform metaphonological operations (e.g., reflecting on language) relating to the recognition and production of rhymes, recognition of the initial syllable of words and finally the classification of words according to their length. This is followed by analytical phonological awareness, which refers to the ability to analyze separately, on an auditory perceptual level, the individual sounds or phonemes that make up words (t, a, v, l, o), the ability of syllabic and phonetic synthesis, phonetic segmentation, deletion of the initial syllable/phoneme, initial phoneme identification, discrimination of phonemes and phonetically similar words.

From a developmental point of view, first the ability to recognize, isolate and manipulate large units of sound (words and syllables) is developed, followed by the capacity to identify intermediate units (onset-first) and finally the ability to manipulate the smallest units of sound: phonemes (Anthony & Francis, 2005). These skills are a fundamental prerequisite for the acquisition of reading and writing and thus for the acquisition of the alphabetic system that is based on the biunivocal correspondence between phoneme (sound) and grapheme (written letter).

There is, however, no unanimous agreement in the literature as to which of these components is most predictive of later reading ability: whereas Bradley and Bryant (1983) suggested that knowledge of rhymes was the most important predictor, Hulme et al. (Hulme, Hatcher, Nation, Brown, Adams & Stuart, 2002) argue that awareness of smaller units of sound (syllables and phonemes) is the best longitudinal predictor. It is important to emphasize, however, that the development of phonological awareness is sensitive to different language proprieties, and, for example, it has been shown that Italian children develop phonemic awareness faster than children exposed to more opaque

languages such as English (Cossu, Shankweiler, Lieberman, Katz & Tola, 1988).

A review (Pufpaff, 2009) has shown that for children as young as 3 years old, syllable fusion is the easiest task, whereas the development of other skills (e.g., segmentation) is conditioned by factors such as word structure and type of instructions given. Research conducted in the Italian context shows that fusion and segmentation skills can be acquired from the age of 4, whereas adequate rhyme recognition can occur from the age of 5 (Martini, Bello & Pecini, 2003; Bonifacci & Giuliano, 2013). Longitudinal studies conducted in Italy seem to suggest that metaphonological competence may be a weaker predictor than other indicators such as visual search and pregraphical skills (Orsolini, Fanari, Serra, Cioce, Rotondi, Dassisti & Maronato, 2003) or verbal working memory (D'Amico, 2000).

Letter recognition

The importance of letter recognition in reading acquisition process has long been argued (Bond & Dykstra, 1967). The child's ability to recognize letters has been defined as one of the most important predictors of reading success along with phonemic awareness (Adams, 1990; Scarborough, 2001; Share, Jorm, Maclean & Matthews, 1984); indeed, the effectiveness of a decoding process is found to be dependent on both the child's access to phonemic language representations and the child's knowledge of letter-sound correspondence. It seems that knowledge of the letter name is in fact used by the child to extract the letter sound, and this seems to facilitate the child in the encoding process, as most letter names contain their own sounds (Evans, Bell, Shaw, Moretti & Page, 2006; Share, 2004). In recent studies (Piasta & Wagner, 2010a, 2010b; Cardoso-Martins, Mesquita & Ehri, 2011), the influence of the knowledge of letter names on the learning of letter sounds was investigated and evaluated, finding that children who were simultaneously taught letter names and letter sounds learned both the sounds that occurred at the beginning and those that occurred in the middle much more easily. Along

these lines, Share (2004) had hypothesized a crucial role of phonological awareness in this process, and subsequent studies by De Jong (2007) and Treiman, Pennington, Shriberg and Boada (2008) suggested, only in apparent contradiction, that the effect of letter-name knowledge on learning to read is independent of phonological awareness, as children with poor phonological skills still demonstrated knowledge of letter sounds, but only of those that recurred at the beginning and not of those that recurred in the middle. From these results one can also easily deduce that the sounds that occur at the beginning of the names of the letters are certainly easier to learn than those that occur in a more salient position, such as in the middle; and these results are consistent with the hypothesis of Treiman et al. (2008) who state that even children with poor phonological awareness are able to take advantage of letter knowledge, to learn, however, only those letters that have their own sound at the beginning of the name.

A recent study by Caravolas et al. (Caravolas, Lervag, Mousikou, Efrim, Litavsky, Onochie-Quintanilla et al., 2012) showed that letter knowledge, together with phonological awareness and RAN (Rapid Automatized Naming), is the main predictor of subsequent reading ability, both in opaque and in transparent languages. It is also interesting to note that letter knowledge is an important predictor even when children are not formally exposed to instruction, as is the case in the Czech Republic (where part of the study was conducted). It is therefore hypothesized that knowledge of letters, even in the absence of formal education, may be an indicator of a child's spontaneous sensitivity to sign-sound correspondence, as it is true that children within the school context are often exposed, for example, to the "sight" of their written name and to activities that in some way involve exposure to letters.

Vocabulary and morphosyntactic comprehension

Vocabulary breadth, in the term of child's knowledge of vocabulary, and his or her ability to understand its meaning can

influence both the process of word recognition in the decoding phase and the process of text comprehension (Nation & Snowling, 1998a, 1998b; Plaut, McClelland, Seidenberg & Patterson, 1996). While decoding is necessary for reading, it is reasonable to assume that grammatic skills and vocabulary breadth are more decisive in influencing the development of the comprehension process. Gough and Tunmer (1986) proposed in their Simple View of Reading model that text comprehension can be considered the product of decoding and listening comprehension skills, in which both vocabulary breadth and morphosyntactic comprehension are certainly involved. Roman, Kirby, Parrilla, Wade-Wooley and Deacon (2009) show a significant effect of morphological awareness in both word and non-word reading, after controlling for the effects of phonological awareness and rapid denomination, confirming the findings of Deacon and Kirby (2004). Also in a recent study, Kirby et al. (Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, L. & Parrila, 2012) confirm the role of morphosyntactic awareness in decoding and text comprehension, suggesting that it should more frequently be included in assessment and reinforcement pathways.

Phonological memory

There are numerous studies in which the relationship between memory functions and multiple aspects of learning and academic success in children has been investigated (Gathercole, Alloway, Willis & Adams, 2006; Gathercole, Brown & Pickering, 2003; Swanson & Jerman, 2007); however, until recently, it has not been clear what contribution each individual function of memory makes to the development of reading ability, as multiple studies have used different tasks to assess this ability and have separately explored the contribution of different memory components, making a unified comparison very difficult. In a recent study, Nevo and Breznitz (2011) investigated in a very analytical manner the contribution that each memory function makes to the reading learning process; the results indicate that all measures of complex memory, and to a greater extent phono-

logical memory measures, are significant predictors of the three basic reading functions. Specifically, the two measures of complex, or active, phonological memory, such as listening recall (recall of words or sentences) and backward digit recall (repetition of numbers backwards), are significant predictors of different aspects of reading ability: children's ability in pre-school listening recall tasks appears to be positively correlated with comprehension ability; whereas backward digit recall appears to be more positively correlated with decoding ability. A measure of complex visuospatial memory such as odd-one-out (identifying a different element among others) appears to be correlated with higher significance with decoding. In this study, decoding ability is explained not only by phonological memory ability, but also by visuospatial memory ability, as also found in other studies (Meyler & Breznitz, 1998; Shatil & Share, 2003).

Game-based assessment

Technology has changed and continues to change our world. Children are exposed to technology in direct and incidental ways, and it has become a part of their everyday lives. It's only natural to explore the ways that technology can enhance their lives and their learning. Over the past decade, technology has begun to have a significant impact on educational environments, and there is growing evidence of the positive impact it has on education (Eiland & Todd, 2019). One of the most prominent examples of technology in education is the use of digital games (De Freitas, 2018). These types of games have become an important tool for families and young people around the world.

A few years ago, it is estimated that there were more than 1000 computer-based interventions for children (Axelsson, Andersson & Gulz, 2016). Furthermore, in 2017 approximately 80% of the best-selling apps in the Apple Store were for preschoolers or educational purposes (Papadakis & Kalogiannakis, 2017). Given this high consumption of video games and apps, that could only

be increased in the last few years, parents and teachers have consistently inquired about their effects on young children (Behnamnia, Kamsin, Ismail & Hayati, 2018). Studies suggest that playing games is positively associated with the development of cognitive skills, motivational and academic performance (e.g., Chan & Sircar, 2017), and attention (e.g., Godwin, Lomas, Koedinger & Fisher, 2015). However, the use of tablets and these apps to assess children's learning is less well known (Carson, 2017), despite the potential benefits of this approach (Neumann, Worrall & Neumann, 2019), there is great enthusiasm in the field of education for game-based assessment (GBA).

Games allow to recreate more authentic situations than traditional classroom activities such as lectures or written assignments. From these situations a large amount of detailed data about students' interaction with the game can be collected, which provides a great opportunity to conduct game-based assessment (GBA) in ways that are not possible in traditional testing (Kim & Shute, 2015).

The advantages of using games as a form of assessment are many: they are engaging and motivating (which leads to more valid assessments), and they allow to create more complex and authentic scenarios needed to assess the application of knowledge and skills (DiCerbo, 2014; Ifenthaler, Eseryel & Ge, 2012; Mislevy, Corrigan, Oranje, DiCerbo, Bauer, von Davier & John, 2016).

Children are naturally playful, and therefore games are crucial in their development (Bento & Dias, 2017). With the advent of GBA, teachers and researchers can assess knowledge and various skills and abilities that are difficult to determine using traditional assessment methods by integrating them into those games. Players also experience motivation, behavior change and deep engagement in these games, providing more reasons for this medium's success (Chan & Sircar, 2017). GBA focuses on collecting, analyzing, and extracting information from data obtained while playing serious games.

Gomez, Ruipérez-Valiente, and García Clemente (2022) re-

cently conducted a literature review on the emerging research field of GBAs. Their main objective was to review empirical studies on digital GBAs published until 2020. Based on a detailed systematic review of the 65 selected papers, they concluded that games are mainly used in education, from pre-school to 16-year-old students, for assessment and validation purposes. The domain of the games used is usually related to STEM and cognitive skills, but other domains emerged from their analysis, such as social sciences and physiological skills. In addition, they note that although few GBA studies had the purpose of proposing an appropriate game design for assessment, most studies used games designed specifically for assessment purposes, employing complex game design elements such as collaboration, narrative, or role-playing.

Józsa, Amukune, Zentai and Barrett (2022) examined 31 studies published from 2011-2019 in a review dedicated to evaluate game-based assessment (GBA) suitability to assess school readiness domains.

Children have been the most targeted group for digital games on computer tablets (Chaudron, Beutel, Donoso Navarrete, Dreier, Fletcher-Watson, Heikkilä et al., 2015), suggesting that game-based assessments on computer tablets might be an effective means of directly assessing school readiness skills in young children.

Józsa and colleagues discussed about the many advantages of the use of games in assessment of school-related abilities. First, they can adopt a real-life scenario that the learner can relate to, thus increasing the learner's motivation, assessment accuracy and reducing dropout rates and test anxiety (Barab, Gresalfi & Ingram-Goble, 2010). Secondly, touch screen technology emulates children's constructivist mode of learning (Orfanakis & Papadakis, 2014). Besides, many computer games share some common characteristics with academic assessments: evidence identification as proof of knowledge and its accumulation; presentation and finalization of activities to accomplish some goal, and presentation of another activity, usually more challenging,

once the previous activity has been completed (Mislevy, Behrens, Dicerbo & Levy, 2012). Usually, to play a game, a player must apply various competencies or other attributes (e.g., creativity, problem-solving, persistence and collaboration), so success in playing could provide a measure of those domains and other learning outcomes (Caballero-Hernández, Palomo-Duarte & Dodero, 2017). On the other hand, Klerk, Veldkamp and Eggen (2015) reported two shortcomings of GBA. Firstly, the interaction of sound, contrasting colors and graphics can affect a child's concentration, especially in a high stakes assessment. Secondly, the amount of process data generated during a game is enormous, making it challenging to identify the elements under investigation.

There are a lot of recent publications about game-based assessment, demonstrating that this is a really hot topic. The use of game in the field of psychological assessment is really up to date by consultants and human resources specialists, but many researchers are studying its implication on children for assessment purpose, but also for improving learning, in school environment and for home rehabilitation.

The familiarity with technological devices and the ability to create extremely user-friendly games allow the use of game-based assessment with very young children, even in preschool years.

Searching the literature, we can find DIESEL-X is a computer game that was developed to detect a high risk of developing dyslexia in preschoolers (Geurts, Vanden Abeele, Celis, Husson, Van den Audenaeren et al., 2015). The game includes three minigames that test the player on three skills that are considered outcome measures that predict the onset of dyslexia: the detection threshold for frequency modulated tones, a phonological awareness test that requires the player to identify words that have the same phonetic ending, and a letter knowledge test. To keep the player motivated during the tests, they are embedded in a computer game.

Rauschenberger, Baeza-Yates and Rello (2022) presented a

work on a universal screening for dyslexia conducted by game, where language-independent content can be used to screen pre-readers who do not have language skills, facilitating possible early intervention. They designed the game content taking into account the analysis of errors made by people with dyslexia in different languages and other parameters related to dyslexia such as auditory and visual perception. They studied 313 children (116 with dyslexia) and trained predictive machine learning models with the collected data.

The technology now available makes it possible to include augmented reality in such projects. RATSEL is an example of this: an Augmented Reality (AR)-enabled, game-based assessment tool to improve the existing school testing methodology to provide sustainable support for children with dyslexia (Sorna Shanthi, Vijay, Sam blesswin, Sahithya & Sreevarshini, 2022). The application includes a variety of subjective games that provide visual and auditory support for exercises and reading activities, making them easier to grasp and understand. The main objective of RATSEL is to provide dyslexic children with a game-based assessment environment using augmented reality technology, which transforms the assessment processes in a more encouraging and hopeful way.

Other reserachers are working on a browser-based game called *Dytective*, designed to detect the risk of dyslexia in English and Spanish (Rello, Williams, Ali, Cushen White & Bigham, 2016). *Dytective* consists of linguistic tasks based on an analysis of common errors made by people with dyslexia. Applying *Dytective* to a population of 60 English and Spanish-speaking children between the ages of 7 and 12, the authors found that children with and without dyslexia differed significantly in their performance on the game. These results suggest that *Dytective* is able to discriminate between school-aged children with and without dyslexia in both English and Spanish speakers.

These are just a few examples of the research available on game-based assessment specifically designed to assess early indicators of dyslexia in preschool children around the world.

That's the sign that this is a consistent line of research that came from a strong connection to the ecological environment and has the potential to become a very useful tool in the field of psychological assessment.

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Bridging the gap
Collaboration between social sciences and the IT sector

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Introduction

The integration of interdisciplinary approaches within the higher education system has become increasingly imperative for addressing complex social challenges. In the Republic of Srpska and Bosnia and Herzegovina, as well as in many other countries in the region, there is a pressing need to bridge the gap between the social sciences and the IT sector in order to effectively address these issues.

In the laws governing higher education in the Republic of Srpska, as well as in the development strategies of higher education in the Republic of Srpska and Bosnia and Herzegovina, including its constituent entities, provisions have been made to advance the digitization of universities and colleges. This entails the establishment of higher quality and more accessible infrastructure, encompassing modern technical equipment such as computers, other IT hardware, and high-quality, high-speed internet connectivity. Additionally, it is noteworthy that a significant amount of unlicensed software is still in use in Bosnia and Herzegovina. According to the Business Software Alliance (BSA), the rate of illegal software installed on personal computers in Bosnia and Herzegovina currently remains at 66 percent, which is the regional average. Given this context, the utilisation of digital tools and methods, along with digital resources, remains limited. When employed, it is predominantly associated with IT-related faculties or projects within the civil sector, typically involving young individuals enrolled in faculties fundamentally linked to information, programming, or software systems.

The "Play Seriously Hackathon" project, supported by the CEI Initiative's

International Project, involving students from the University of Banja Luka, represents a pioneering hackathon challenge in Bosnia and Herzegovina. Not only did it mark the inaugural hackathon challenge, but it also represented the first project to integrate tools and techniques from the IT sector into social sciences (specifically psychology and pedagogy) and artistic disciplines. This hackathon challenge has served as a means to better comprehend the necessity for enhancing digital and informational tools, methods, and techniques in higher education, with a particular emphasis on social sciences, especially psychology.

While hackathons and similar activities contribute to various aspects and objectives in education and professional development, their use for educational purposes has only recently garnered attention in research (Oyetade et al., 2022; Trainer et al., 2016). The most frequently considered aspects of hackathon challenges encompass multidisciplinarity, the advancement of practical and applicable knowledge, as well as an understanding of the work environment. Additionally, discussions often revolve around the cultivation of creative and innovative thinking, along with work-related aspects, and the enhancement of other professional skills such as communication, presentation, teamwork, and more.

The term "interdisciplinary approach" is defined as the convergence of two or more disciplines, promoting interaction and influencing each other's perspectives (Rowntree, 1982, p. 135, as cited in Ivanitskaya et al., 2002). Furthermore, it can also be viewed as the application of a novel conceptual framework that integrates and adapts multiple disciplinary approaches (Graybill et al., 2006, p. 757). The significance of interdisciplinary collaboration has been widely acknowledged in academic literature. Such research fosters innovation and equips scholars to address multifaceted problems that extend beyond the scope of a single discipline (Derry et al., 2014). Moreover, interdisciplinary programs have demonstrated various positive outcomes, including

enhanced thinking and learning skills, improved cognitive abilities, heightened creativity, and an enhanced sensitivity to ethical dimensions. These programs also cultivate a capacity for proactive and autonomous thinking, the ability to synthesise knowledge, and the confidence to challenge expert opinions (Ackerman, 1989; Ackerman & Perkins, 1989; Field, Lee, & Field, 1994., as cited in Ivanitskaya et al., 2002).

One area necessitating innovative and collaborative solutions is child developmental problems, where early intervention and precise diagnosis are paramount. Drawing inspiration from the success of the Hackathon project, which applied a hackathon methodology to impart interdisciplinary problem-solving skills for population health (Radzihovsky et al., 2022), this research adopts a similar approach to develop a game for identifying and diagnosing specific learning disabilities among young children. The hackathon methodology has shown promise as a pedagogical tool for fostering collaboration, problem-solving, and innovation skills (Radzihovsky et al., 2022).

The practical application of knowledge and the simulation of working conditions are highly esteemed in hackathon challenges and represent key facets of the endeavour. Indeed, the practical application of knowledge in academic settings is often a challenge and a continuously evolving domain, seeking examples of how to reconcile academic knowledge with the practical skills requisite for employment. Szymanska (2020) emphasises that hackathon participants apply their theoretical knowledge to real-life projects, allowing them to discern how their academic education can be translated into practice. Hackathons constitute an effective working method among student populations for cultivating entrepreneurial thinking and are more efficacious in instructing students compared to conventional methods. They also nurture entrepreneurial self-confidence and independent thinking (Szymanska, 2020; Lara et al., 2016).

Innovation and Creativity: Engaging in hackathons fosters innovative thinking and creative problem-solving, which can yield broader societal and economic benefits. This method offers

a wide avenue for the exchange of ideas, enabling the bridging of cultural or regional differences and providing innovation that is universal and applicable in a broader context (Butt et al., 2020). A study conducted by Cwikel and Simhi (2021) on the use of hackathons in the field of social work education revealed that this method promotes and enhances creativity, teamwork, and collaboration. However, they also found that competitiveness and rewards diminish the positive experience of hackathons. Lazzarotti and Manzini (2009) have taken a step further, contending that the hackathon model precisely facilitates the process of open innovation. In situations where there are certain impediments to the development of innovation and creativity, this model encourages further progress. Wankel (2016) also highlights the cross-cultural advantages and the unique significance of cultural, geographical, or regional differences that can contribute to innovation and the creative process, as well as in networking among individuals. Such exchange of ideas and innovative accomplishments not only allows new knowledge to be implemented at its source but also simultaneously in diverse cultural and geographical contexts.

Professional Skill Development: Participants in hackathons acquire various skills, including programming, design, communication, and project management, which are crucial for success in the contemporary business world. Lyndon et al. (2018) highlighted in their research that students were empowered to take an interdisciplinary approach to their work precisely because of the hackathon challenges they participated in, and that this experience can be successfully applied in a real-world environment. Lazzarotti and Manzini (2009) state that hackathon challenges enable young professionals to receive better and higher-quality training in an environment that is safe and conducive for them. Preparing students/young professionals for work in a real work environment, which, in controlled conditions, enhances their capacity for a deeper understanding of project phases, communication and presentation skills, i.e. everything necessary for work, communication, and collaboration with colleagues (Ghouila et al., 2018).

In conclusion, this study aims to address challenges in integrating interdisciplinary approaches within higher education systems, particularly in the social sciences of the Republic of Srpska and Bosnia and Herzegovina. The study is bolstered by the support of the CEI Initiative's International Project and is manifested through the Play Seriously Hackathon, an initiative that engages students from the University of Banja Luka. The study strives to enhance education, bridge gaps, and foster innovative solutions to societal challenges.

Method

This research examines the Play Seriously Hackathon project, which involved students from the University of Banja Luka and the private University Apeiron Banja Luka. The participants were enrolled in undergraduate programs such as Psychology, Pedagogy, Academy of Sciences and Arts, Electrical Engineering, and Faculty of IT and Software Engineering. This project aimed to explore the understanding of Specific Learning Difficulties (SLD) development and propose a game design for children aged 5 to 7. The hackathon model provided a platform for students to acquaint themselves with new learning and working tools, and to apply theoretical knowledge to innovative work concepts. Furthermore, the project facilitated multidisciplinary collaboration and introduced a novel approach to project-based learning within the specified faculties and programs.

The Play Seriously Hackathon project engaged a total of 10 students, divided into two teams. Since previous research has shown that genuine and effective leadership contributes to the success of a team, each team had a team leader who defined the timeline of work and also conveyed project information to other team members (Avolio & Gardner, 2005). The teams operated independently on project tasks and the implementation of project objectives. This hackathon marked the students' inaugural exposure to this mode of work.

The participating students predominantly pursued degrees in psychology, with some engaging optionally in graphic design, painting, and programming. Their prior knowledge encompassed stages of typical development in children aged 5 to 7, as well as insights into the processes of speech, learning, and perception. This project served as a testing ground for the transfer of theoretical knowledge into practical tasks and realistic applications.

The utilisation of a hackathon as a working tool was unprecedented in the mentioned faculties and programs. Additionally, the collaboration across diverse study programs and faculties around a common objective was not customary, especially within the context of the aforementioned institutions. The hackathon model facilitated exposure to new learning and working tools, enabling students to implement their acquired theoretical knowledge into the development of innovative work concepts.

In addition to this, participation in the hackathon challenge aimed to monitor the work and development of students on several levels. Firstly, it encompassed learning to comprehend the broader needs of the community, specific target groups, understanding the functioning of the market and its principles, and the practical application of acquired academic expertise. Overall, the importance of this approach lies in its emphasis on a holistic approach to learning and problem-solving. It combines theoretical knowledge (academic expertise) with a practical understanding of the environment in which that knowledge will be applied (community needs, target groups, market principles) (Dholakia et al., 2004; Goh & Burns, 2012). An integral aspect of the hackathon challenge for students was the formation of teams, collaborative work within teams, and work under time constraints.

The work was defined in several phases, which are as follows:

a) Preparation phase and team formation – initially, it was planned to have one team consisting of 5 students, however, during the project promotion, more students expressed interest and formed an additional team.

b) Familiarisation phase with thematic content and technical aspects – in this phase, all students had common meetings

and received instructions from the project coordinator regarding which content to study. Students independently sought out scientific and informational materials, and in subsequent meetings, exchanged their knowledge. Questions, uncertainties, or ambiguities were addressed to the coordinator and other professors, seeking further clarifications.

c) Hackathon challenge – on the actual day of the hackathon, which lasted for 12 hours, students were divided into two groups and worked separately. Two professors were present at the event, supervising their work and assisting in organisational and technical aspects.

d) Finalization of the hackathon idea and report writing – students were provided with additional 7 days to conclude their hackathon idea and to write a report according to specified instructions.

e) Evaluation and promotion phase in the local context – students expressed a desire to conduct a promotion of the hackathon challenge and present the results of their work. The presentation took place at the Faculty of Philosophy, with attendance of over 120 students and professors.

f) Development of a demo version, which took place several months after the project's commencement, entailed preparing a demo version of the project idea for each team. The team had the freedom to shape the demo version in the manner they deemed appropriate and how they wished to present their project.

Throughout each phase, discussions were held with the students about the project's objectives, as well as objectives focused on personal growth and development, and their experiences with this working model. An analysis of content was conducted through descriptions and qualitative expressions, enabling a deeper insight into the students' experiences.

Results

During the hackathon challenge, two teams created two games

according to defined task parameters, both of which included all the elements required by the challenge. Each task was different, meaning it had a different story, defined characters, creative and visual design. Each created element of the game adhered to the rules of the psychological and pedagogical profession in terms of task difficulty, method of task resolution, etc. Additionally, both proposed solutions that addressed the ethical aspects of the game for minors.

Through the analysis of the work phases, it was noticeable that the students lacked experience in this mode of work, and their expectations were oriented towards gaining insight into a different way of working and applying learned material through extracurricular activities, while finding it interesting and enjoyable. Furthermore, for psychology students working in the field of design and IT, and for IT students, working in the field of psychology and pedagogy was interesting as they acquired new knowledge.

The teams were formed in two ways: the first team was proposed by the coordinating professor, while the second team was formed by the personal choice and organisation of the students. The team that formed independently had better cohesion and collaboration from the beginning, which was not particularly pronounced in the initial phases of work (Juli, 2012). As the project progressed, this became significant in the functioning of both teams.

Both teams had the same level of motivation and focus during the hackathon challenge. Everyone demonstrated a high level of concentration, professionalism, and collaboration. The hackathon challenge connected team members into a unified whole where it was clear who was doing what and how they contributed to the overall process. At the beginning of the hackathon challenge, it was a challenge to allocate roles and coordinate work, but as time went on, everyone found their role in the team. Team members were open to professors and sought help regarding how to organise, but also provided their own suggestions.

Work during the hackathon challenge went through all the

phases of team work on a project with limited time duration. Initially, there was a high level of motivation and organisation, followed by segments where fatigue and inefficiency plateaued, and after that came the "aha effect" for a specific phase of work (Wills et al., 2006).

It is interesting to note that the time limit did not particularly leave an impression on the students, nor did they feel pressure due to the limited work time. It gives the impression that students have experience in working with limited time and that they assess the remaining work time and which tasks they can complete in that period.

All students emphasised that working on the hackathon challenge was an inspiring experience for them, where they learned a lot. They all highlighted a high level of motivation and competitive spirit. They greatly enjoyed the environment in which they worked: the informal way of sitting, the possibility to have refreshments and food, and the break for a meal. The possibility to communicate and coordinate with colleagues in the team throughout the entire time without it being considered inappropriate behaviour in class was appreciated.

Networking and contact with colleagues in Italy and other countries, as well as occasional online conversations with other significant individuals in the project, had an additional motivational effect. Discussing current steps and achieved solutions allowed teams to see how far they had come compared to the previous period and motivated them to take a step further before the next discussion.

The presence of professors in informal communication, as well as their support for all technical and organisational needs, instilled a sense of security in the students and, as they stated, provided them with a safe foundation for work, as well as the possibility to have "silly ideas" that professors would not view negatively.

Overall, the hackathon challenge as a method of work and learning was rated positively by the students as an experience that contributed to faster learning, connecting information, and

a more serious understanding of the need for theoretical knowledge in practical application. Additionally, the understanding of the importance of teamwork and respecting the opinions of other colleagues was increased. According to Wallwey et al. (2022), hackathons present valuable opportunities for students to gain insight into the complexities and interdisciplinary nature of addressing intricate and demanding problems. To promote the development of high-quality hackathon challenges facilitated by teams with a wide range of expertise, it is crucial that the hackathon setting cultivates an atmosphere in which participants are in sync with the subject of interest, possess clearly defined actionable goals to address, and implement mechanisms for cooperative knowledge exchange to guarantee the formulation of a viable solution. All emphasised that interdisciplinary knowledge and gaining information and knowledge from other core disciplines were of great benefit. Newell (1994) suggested that the outcomes of interdisciplinary learning lead to improved cognitive and affective performance, enhance the ability to address complex problems, and also foster critical reasoning.

Furthermore, unlike the hackathon challenge, working on the report had its difficulties. First and foremost, there was the difficulty of organising the timeline of work and dividing tasks, determining who was responsible for which part. In one of the teams, there was a significant delay in work because the team member responsible for the narrative part of the report dropped out, and the takeover of that task did not proceed smoothly. The team later stabilised and completed their work and report on time. The withdrawal was explained by the excessive amount of other obligations and the unexpected additional responsibilities. Both teams marked the concept of writing the report and creating all the necessary elements as in line with their capacities.

Students demonstrated a high level of motivation even after completing the report by presenting the entire project at the Faculty of Philosophy in order to show professors and colleagues everything they had worked on. It was very important for them to evaluate their work and present this innovative concept to

both colleagues and professors. Positive feedback from both professors and colleagues gave students a sense of completion and rounded off the hackathon challenge project.

Table 1. Participant Allocation by Phase

Project Phases	Participants
Preparation and Team Definition Phase	10
Familiarisation with Content and Technical Aspects of the Topic	10
Hackathon Challenge Phase	9
Finalization and Report Writing Phase	9
Evaluation and Promotion Phase	9
Demo Version Creation	5

Table 1 provides an overview of participant allocation across various phases of the project. The project is divided into five distinct phases, each requiring a different level of participant involvement.

Table 2. Overview of contributions to student development through the hackathon challenge method.

Project Phases	Activities	Contribution to Development
Preparation and Team Definition Phase	Project presentation and methodology	Real-world problem solving, interdisciplinary learning
Familiarisation with Content and Technical Aspects of the Topic	Collaborative work with other faculties	Exposure to diverse perspectives, understanding others
Hackathon Challenge Phase	Independent research and discussions	In-depth knowledge acquisition, practical application
Finalization and Report Writing Phase	Teamwork and task management	Enhanced teamwork satisfaction, clear goal specification

Evaluation and Promotion Phase	Promotion and education outreach	Peer education, endorsement from professional community
Demo Version Creation	Demo version creation and PR planning	Efficient project completion, clear project goals and timeline

Table 2 provides an in-depth overview of the contributions to student development facilitated by the hackathon challenge method across different project phases. It outlines specific activities undertaken during each phase and highlights the corresponding benefits to student growth and learning. For instance, in the "Preparation and Team Definition Phase," activities such as project presentation and methodology lead to real-world problem-solving skills and interdisciplinary learning. Similarly, in the "Familiarization with Content and Technical Aspects of the Topic" phase, collaborative work with other faculties results in exposure to diverse perspectives and a deeper understanding of others' viewpoints. Throughout the various phases, the table emphasises the holistic educational benefits derived from each activity within the hackathon challenge framework.

However, the continuation of the project, which consists of creating a demo version of the project and engaging in PR activities to promote the project, subsequently defined and presented to the teams, led to the complete withdrawal of one team. This is the team in which originally one student dropped out. It is important to note that this is the team that was first formed and the one in which originally a student dropped out. Furthermore, considering that 4 out of 5 team members withdrew, this team was unable to continue further with the project. There are several reasons cited by the students: subsequent information that they did not have at the beginning of the project, which did not align with their initial project setup, and they could not adapt to the additional tasks or new expectations in the project. They also mentioned that they expected additional satisfaction for participating in the project, such as financial incentives or additional facilitations in their overall university commitments (extra credits,

recognition of passing the written part of the exam or the entire exam by the professor who was part of the team, etc.). It is also noted that the new information they did not have at the beginning of the project affected poor personal organisation and the inability to coordinate commitments. The level of collaboration within the group was very low, and motivation had completely dwindled.

Although the task was clearly specified, the deadline was long enough, which was emphasised by the second team that stayed until the end and completed the task - this was not motivating enough for the first team. The second team, consisting of 5 students, stated that the task was challenging, but what was highly motivating was that the demo version of the project would be presented to potential investors and the wider public. The opportunity for additional audiences and professionals to see the team's project, and for both the team and the university they attend, as well as the country they come from, to be promoted, was highly motivating for them to stay committed until the end of the task. All of this was not sufficient motivation for the first team.

Out of a total of 10 students who applied to participate in the hackathon challenge, 5 of them remained highly motivated from the beginning to the end of the project, and they valued all phases of work as a challenge they wanted to overcome in the highest quality manner given the circumstances. The team that did not stay until the end of the project showed a high level of motivation in the preparatory phase of the hackathon challenge; however, with the passage of time and new tasks, the level of motivation for further participation decreased, and the reasons became more complex and varied.

Discussion and Next Steps

The Hackathon challenge utilised in this project proves to be an effective tool for addressing complex tasks and questions rel-

evant to specific fields within psychology, developmental issues, as well as identification and diagnosis in the realm of learning problems. This study investigates how the Hackathon challenge, as an interdisciplinary approach, can serve as a motivational tool within an academic environment, contributing to the diversification of working methods and enhanced information assimilation, particularly for non-IT sector students.

Several aspects have been identified as crucial for students, irrespective of whether they are majoring in social sciences, arts, or IT-related fields:

Interdisciplinary Approach - This approach has demonstrated its exceptional utility in teaching students an interdisciplinary approach to topics and problematic situations. Students were exposed to knowledge from various scientific and practical aspects within the academic environment for the first time. Initially, this was highly engaging for students and provided them with impetus for more in-depth exploration and work on the project. The additional knowledge, not strictly related to their field of study, was deemed highly beneficial, instilling a sense of confidence, enhancing personal competitiveness, and providing a feeling of satisfaction. It is further believed that such knowledge would contribute to future employment prospects and the ability to make informed career choices. Notably, the collaboration and knowledge exchange between disciplines bolstered students' self-confidence in later stages of their studies and in the job market. The interdisciplinary approach allows for greater student mobility within the University and various study programs, promoting interpersonal skills and adaptability in new situations.

Simulation of Working Conditions - This aspect holds particular significance for understanding real-world work and life situations, especially when students lack experience in companies and institutions. The Hackathon challenge is realistic, offering students a context in which they can assess how their academic knowledge on specific topics and areas aligns with the practical requirements of a real work environment (Pažur & Divjak, 2022). The most important consideration for them is the realistic

simulation of a working environment, which refers to concrete project tasks, guidance from employers and constructive feedback. Within the ICT study area this connection to real working environments in student project work is recognized as authenticity (Abad et al., 2019). This aspect of the hackathon, testing the applicability of academic knowledge in a relatively safe environment for students, has proven to be a significant and effective method of learning in higher education. Identifying environments that, although not directly related to employers, provide realistic working conditions enabling students to demonstrate a broader range of skills and competencies crucial for future jobs. Factors we can define as work skills or professional competencies are highly emphasised in this mode of work, enabling students to recognize and develop them within themselves. Some of the highlighted factors include understanding instructions, effective communication with colleagues, proper task allocation, understanding one's own tasks, and the ability to connect them with other tasks. The assessment or development of these skills plays a crucial role in preparing students and professionals for successful careers, contributing to their ability to integrate successfully into work environments. In addition to understanding work tasks, skills that are developed and emphasised during hackathon challenges include teamwork or team efficiency (McManus & Rook, 2021). These factors pertain to an individual's ability to work effectively in a team environment and involve communication with colleagues, adhering to team rules, understanding one's position or role in the team, and contributing to the team's goal. Teamwork is a key component of success in many organisations; hence, developing skills related to teamwork plays an important role in achieving efficiency and productivity in the hackathon environment (Barr, 1997).

Motivation for Participation in Academic Environment and Hackathon Challenge Motivation for students in the academic environment and participation in the Hackathon challenge was twofold: serving as an external and internal motivator, and it remained the most influential factor throughout the project.

External Intrinsic Motivation

Contribution to the Community - The theme defined in the hackathon task was highly motivating for all students. There was a great willingness to learn about child development, learning issues, and how to make the created game both interesting and educational for children. Students worked and created with full awareness that the game could potentially be on the market and genuinely used by children.

Competitive Spirit - A positive competitive spirit existed, motivating students from Bosnia and Herzegovina to participate and showcase their knowledge in an international project in the best possible way. This was a significant driver for their work.

Visibility and Recognition - The importance of visibility as a strong motivator was demonstrated, as students themselves requested to present their work to the broader public, colleagues, and professors. Project presentations, comments, praise, and media promotion were significant sources of satisfaction for the students, providing them with encouragement to stay in the project longer and complete elements that were not initially planned. The existence of specific rewards and rankings was also a significant motivator (Hidi, 2016). This became particularly evident as the project's duration increased. As the reward (financial, points, etc.) was absent, one team lacked the capacity to stay in the project until the end. The absence of a reward as an external motivator and the inability of other external and internal motivators to compensate led to the team's disintegration and the inability to focus on the remaining tasks and complete them. This was something that was not anticipated at the outset of the project and represents a specific segment of this project that warrants further study and exploration of adequate initial setups to predict and find ways to address such behaviour inadequately in future projects. Issam Attalah (2023) concludes in his work that the existence of usefulness for hackathon participants is important and does not necessarily have only direct financial implications; rewards can also be in the form of contributing to specific public policies or participating in their creation.

In addition to external motivational factors, the most significant impact was made by internal motivational factors, which proved to be the strongest driving force for students who remained until the end of the project (Weber, 2003).

Research Curiosity - Students displayed a high degree of interest in scientific fields and their practical application, as well as an understanding of the needs of vulnerable groups and the improvement of resources for early diagnosis and learning.

Acquiring Knowledge - All students showed a high willingness to understand academic knowledge in a practical context and to re-learn everything necessary for the hackathon challenge, both in their own field of study and in the areas their team members specialised in. As the task progressed and the need for operational knowledge grew, students increasingly desired to understand how to transform their academic knowledge into practical tasks and use it in the most appropriate and creative way.

Holistic Approach - The opportunity to learn and understand other fields and disciplines. Connecting different academic and practical knowledge, learning from colleagues about areas that are not the primary focus of their studies, and showcasing their own expertise, such as programming, design, painting, which are not the subjects of study for individual students, were particularly motivating. For psychology and pedagogy students, it meant a great deal to demonstrate their other skills and knowledge, and to have these abilities valued by colleagues and professors.

It is important to note that motivation often varies among individuals and can be a combination of internal and external factors. For some, internal motivators are crucial, while others may be more incentivized by external rewards and recognition. The combination of these factors often leads to the best results and engagement in the academic environment and hackathon challenges.

Based on the foregoing, the following steps or practical actions that could be taken based on the knowledge and experiences gained from Hackathon challenges within the academic environment can be defined.

Here are several potential future steps:

Integration of Hackathon as a Working Method in the Educational Program: Consider the possibility of formally incorporating hackathons as part of the university's educational program, especially in the field of social and humanistic sciences. This would enable students to gain interdisciplinary experiences and skills as part of their regular studies.

Development of Courses and Programs for Interdisciplinary Learning: Create specific courses or programs that promote interdisciplinary learning and project work similar to a Hackathon. This would provide students with a structured opportunity to acquire diverse knowledge and skills.

Recognition of Interdisciplinary Work: Ensure that interdisciplinary work and the skills students acquire through Hackathon are recognized and valued within the university system, for example, through extra credits or pre-exam obligations.

Promotion of Teamwork: Promote teamwork as a key component of education.

Departments and study programs should organise explanations of the benefits of teamwork and conduct courses or workshops on team collaboration to help students develop these skills.

Continuous Monitoring and Evaluation of Motivational Factors: It has proven to be very important, especially in the context of long-term work and learning, to pay attention to motivational factors. Continue researching student motivation and identify new factors that may influence their participation in projects like Hackathon. This would enable the improvement of strategies for maintaining a high level of motivation.

Consideration of Support/Material Rewards: Consider options for providing financial or other material resources (paid courses, study trips) as support for students participating in Hackathon challenges as an additional external motivator.

Building Partnerships with Industry, Especially in IT Technologies and New Technology Development Sectors: Establish connections with companies and institutions to enable students studying social sciences to demonstrate the significance of their knowledge

and work in these areas. This could provide students with access to real working conditions and opportunities for the practical application of their skills.

Continued Research on Challenges and Barriers: Understanding the intrinsic reward as a motivator requires further investigation, particularly in the context of new generations of students, and the development of strategies to overcome them.

Promotion of Interdisciplinary Work and Team Skills: Continuously promote the importance of interdisciplinary work and teamwork skills as crucial elements of success in education and careers.

Monitoring the Career Success of Students: It would be beneficial to track the careers of students who participated in the Hackathon to assess the impact of this experience on their future employability and success in their professional lives.

These future steps can help universities better harness the potential of Hackathons and similar interdisciplinary projects in their educational programs and provide students with the opportunity to acquire a wide range of knowledge, skills, and motivation.

Conclusions

The Hackathon challenge with topics in the field of social sciences, specifically those closely related to psychology, pedagogy, and other assisting professions within the context of higher education in the Republic of Srpska and Bosnia and Herzegovina, has proven to be a valuable tool for enriching students' academic experience. This Hackathon challenge was the first of its kind in Bosnia and Herzegovina, where participants from social science backgrounds were on equal footing. It demonstrated that an interdisciplinary approach, recognition of fundamental knowledge, as well as the simulation of work conditions and motivational factors, play a crucial role in fostering student engagement, developing their skills, and preparing them for future

challenges.

Future steps, in alignment with the digital transformation of society, the educational sector, and consequently, the work environment, should encompass the integration of such initiatives into the educational system. This should include continuous monitoring of motivational factors and support for teamwork, enabling students to realise their full potential and contribute to society and the professional world. Hackathon challenges serve as a bridge between theory and practice, empowering students to evolve as competent and motivated professionals.

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Predicting Dyslexia in Children Through Game-Based Screening: Introducing Fluffy the Game

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Introduction

In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the term 'learning disorder' has been redefined as Specific Learning Disorder (SLD) (Prelock et al., 2018). SLD refers to a neurobiological condition that affects individuals' learning processes, resulting in persistent difficulties in reading, mathematics or writing (Bonifacci et al., 2016; Pham & Riviere, 2015). It encompasses challenges within four distinct areas: dyslexia (reading disability), dysgraphia (writing disability), dyscalculia (mathematics disability) and dysphasia (language disability) (Prelock et al., 2018). SLDs can potentially lead to academic underachievement, decreased self-esteem, heightened psychological anxiety, mental health issues and, ultimately, professional challenges (American Psychiatric Association, 2013). It is important to underline that these difficulties are not linked to an individual's intelligence and individuals with SLDs encounter substantial daily challenges, especially within the context of education (Alqahtani et al., 2023).

In particular, dyslexia is the most prevalent SLD, accounting for at least 80% of SLD cases (Kohli et al., 2018) and affecting approximately 5%-10% of children worldwide (American Psychiatric Association, 2013). Children with dyslexia often grapple with low self-esteem, stemming from emotional challenges associated with academic setbacks or familial pressures for academic success. Current interventions typically require

additional time compared to daily school activities and are not universally accessible and affordable for all families (Gooch et al., 2016; Ozernov-Palchik & Gaab, 2016).

Specifically, all SLDs, including dyslexia, can only be effectively diagnosed after the age of 7[1], but there are specific indicators that can serve as predictors even before the age of 7. These general indicators include: language delay of processing, poor concentration, motor difficulties, letter recognition difficulties, forgetting words, difficulty following instructions[2]. These early signs of dyslexia manifest in the preschool years. Consequently, interventions for SLDs are most effective during preschool and early elementary school (Gaab et al., 2021; Ozernov-Palchik & Gaab, 2016). Predictive indicators, dyslexia assessment and interventions can be initiated as early as preschool age, starting at 4 years old, to prevent the reduction of children's self-esteem and to minimize the severity of their reading disability as early as possible (Gaab et al., 2021). Early identification of potential dyslexia in children is crucial, as it increases the likelihood that a child with dyslexia can benefit from effective intervention programs and improve their skills (Isa et al., 2021).

In recent years, global studies have explored the application of Information and Communication Technologies (ICT) for dyslexia screening across all age groups. This screening process is crucial for identifying individuals with difficulties, laying the foundation for effective interventions. Consequently, ICT is emerging as a valuable supplementary strategy, offering cost-effective and easily accessible advanced tests to gain a deeper understanding of students' learning profiles (Drigas & Politi-Georgousi, 2019). Transforming the diagnosis process into a form of play can be a way to create a safe space for the child and encourage greater engagement (Dymora & Niemiec, 2019; Sailer et al., 2017; Westera, 2019; Zubek, 2020).

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1 https://www.dyslexiauk.co.uk/at-what-age-can-a-child-be-assessed-for-dyslexia/

2 https://www.bdadyslexia.org.uk/advice/children/is-my-child-dyslexic/signs-of-dyslexia-early-year

Furthermore, some research has demonstrated that Game-Based Interventions (GBI) can rekindle motivation in individuals with SLD who tend to avoid and are reluctant to engage in routine intervention methods (Holmes, 2011; Holz et al., 2018). Employing game design concepts can enhance the motivation of children with writing disorders (Dui et al., 2020). Several studies have shown that the systematic use of certain types of games, gamification, and serious games can contribute to improving the skills of children diagnosed with dyslexia (Khaleghi et al., 2022).

Based on these premises and leveraging a set of exercises utilized for diagnosing dyslexia provided by Hogrefe[3], within the context of the #PlaySeriously[4] hackathon organized by the SAE Institute[5] in November 2022, Fluffy was developed. Fluffy's primary objective is not only to serve as a predictive tool for identifying initial signs of dyslexia but also to provide an engaging resource that, through sustained use, can lead to improvements in the performance of children with dyslexia.

The chapter is organized as follows: in the next section we will delve into Fluffy from a conceptual perspective, elucidating its concept and story framework. Subsequently, we will explore the rules and core mechanics, followed by an examination of the user experience and user interface. Lastly, we will present each level of Fluffy comprehensively, discuss conclusions and future prospects.

Fluffy – the game

Digitizing four separate exercises to predict dyslexia led to the creation of Fluffy – the game[6]. Fluffy is a game designed for

3 https://www.hogrefe.it/

4 https://www.sae.edu/ita/hackathon-play-seriously/

5 https://www.sae.edu/ita/

6 The prototype of the game graphically implemented on Figma can be viewed at the following link: https://www.figma.com/proto/iHX2pBpxALxXgizlZVXHMq/Hackathon-PlaySeriously-Fluffy?embed_host=notion&kind=&node-id=553-35383&page-

children aged 5-7 years old, aimed at predicting early signs of dyslexia through a series of games related to the adventures of Fluffy, a space kitten who wants to explore new planets in search of balls of yarn. The choice to create a story with a meaningful story and a character is based on children's game design to make it as engaging as possible (Valenza et al., 2019).

We decided to develop this game for iPads and tablets because they are the best devices for children aged 5-7 years for several reasons (Blum-Ross & Livingstone, 2016; Hadlington et al., 2019; Oliemat et al., 2018): they are easily transportable, but they are not as small as cell phones, making them optimal for children to play on a variety of occasions, thus increasing the likelihood of social interactions with other children and making it easier for them to engage in more practice. They then satisfy motor skills by providing a sense of direct manipulation during play, compared with computer interactions (Valenza et al., 2019). Also, in order not to overload the child's memory, we chose to avoid keyboard interactions (Valenza et al., 2019).

Concept and story spine

The main character is Fluffy, an astronaut kitten. The choice to use an animal is based on educational evidence indicating that growing up with an animal helps children develop empathy skills, as well as learn to play respectfully, cultivate patience, appreciate diversity, and build bonds (Blue, 1986; Siegel, 2004). The specific choice of a cat is attributed to the curiosity and independence characteristic of this pet, aligning perfectly with Fluffy's adventurous spirit (Travnik et al., 2020). Furthermore, Fluffy's young age, clearly that of a kitten, is meant to not only embody the curiosity typical of children but also to forge a deeper connection with young audiences. Fluffy's name is inspired by the soft texture of the pudding they have, reminiscent of the way

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id=0%3A1&scaling=scale-down&show-proto-sidebar=1&starting-point-node-id=553%3A35383&viewport=-1958%2C-5647%2C0.19&mode=design&t=o93w8Sd0hvqZQtW3-1

the kitten floats gracefully in weightlessness. It also phonetically evokes the sensation of floating in space, mirroring Fluffy's spacesuit and helmet. Fluffy's missions unfold in a semi-fictional galaxy, as space-themed settings were a requirement of the #PlaySeriously hackathon. Fluffy hails from Planet Earth, so their missions commence on our home planet. However, the planets they visit bear fictitious names such as *Artune*, *Balert*, *Caranus*, and more. The planets' names are arranged alphabetically, serving as a tool to help children with learning difficulties associate and practice the alphabet, linking the first mission with 'A' and the last mission representing 'Z'.

The adventures are based on the concept that Fluffy must undertake missions to new worlds, facing a series of challenges that lead to the discovery of a new ball of yarn to play with. Each mission consists of four levels, each representing a distinct exercise:

In the first level, Fluffy prepares a backpack by recognizing an image that is not coherent with the others.

The second level involves guiding the space pod to the planet by matching shapes in the sky with the one drawn behind the space pod.

Upon arrival on the planet in the third level, Fluffy exchanges gifts with the inhabitants. The locals offer an object, and Fluffy must reciprocate with an object sharing the same initial sound, choosing from a set of three.

In the fourth level, Fluffy seeks out the yarn shop. To do so, Fluffy follows the directions of the locals, but they are not always accurate. Fluffy must distinguish correct from incorrect directions by discriminating between associations of phonetically similar and different words.

Rules and Core Mechanics

Fluffy is organized into missions, each represented by a specific planet. Each mission consists of four levels:

- prepare the backpack for the mission;

- guide the space pod to the planet;
- land and exchange gifts with the planet's inhabitants;
- follow the directions to the ball of yarn store and collect it.

The missions are arranged in ascending order of difficulty. However, the progression is designed to be gradual, allowing children to improve without feeling overwhelmed by excessive difficulty (Valenza et al., 2019). The mission's overall difficulty increases as you advance through the four levels within it. Level complexity grows by incorporating more challenging elements into the game, such as adding more objects or shapes (never exceeding five, as the appropriate exercises suggest) or using more intricate sounds. Additionally, the number of exercises within each level increases, starting at five and gradually increasing. After completing each level, the player receives a score ranging from one to three stars. This scoring system encourages players to replay the level to achieve a higher score. Furthermore, upon completing each mission, the player can view the average of the scores obtained across the four levels, also ranging from one to three stars. In this case, the feedback loop motivates players to replay the entire mission to achieve a higher overall score (Valenza et al., 2019).

User Experience

Our primary user is a child aged 5 to 7 years, likely with dyslexia. Consequently, we designed a user experience that guides them in an environment as safe as possible. To minimize performance anxiety, we made several decisions to avoid game mechanics that could trigger negative emotions in the child. Specifically, we opted not to introduce time pressure, as it may induce anxiety in children. Additionally, we completely avoided implementing rankings to prevent children from feeling discouraged by their positions (Oliemat et al., 2018; Pham & Riviere, 2015). We utilized simplified scoring systems suitable for children, such as using three stars to indicate the quality of their performance at both the individual level and the overall

task, thus avoiding the use of numerical values. Furthermore, the collection of different balls of yarn on each planet was incorporated to stimulate creativity and diversity. In line with most games for children in this age group, we believed that having an explicit "failure" in the game would not be beneficial, as it could lead to frustration and abandonment of Fluffy's missions. These missions serve not only for prediction but also for training. Individual levels (and consequently, the entire mission) cannot result in failure; the child can never lose. Even if they encounter difficulties in certain exercises within the levels, Fluffy will guide them to try again and offer assistance. The level will always be passed, albeit with varying scores represented by stars. This encourages the child to revisit the mission to aim for a perfect score, promoting practice. Simultaneously, these scores serve as valuable predictive signals for parents. Fluffy's missions provide a secure space where children can make mistakes, think critically, and learn without the pressure of time constraints or fear of losing lives. Furthermore, the game's structure does not explicitly reference dyslexia, making it an inclusive game suitable for any child. This approach promotes social inclusion among children, regardless of whether they have specific disorders.

Our user base extends beyond children to include their parents. Consequently, we have designed a dedicated website for parents to monitor their children's progress and gain predictive insights into dyslexia. Initially, we considered integrating this section within the app and restricting access with a password known only to parents, in order to prevent children from viewing their potential errors and to satisfy their curiosity. Within the game interface, there will be a star-based measure to help children improve in individual exercises and encourage practice. On the website, however, parents will have access to aggregated data, categorized by exercise type, allowing them to identify areas where their child may be experiencing difficulties.

User Interface

All graphic design choices have been guided by principles of accessibility, with a particular focus on those designed to accommodate dyslexic children. We have implemented Lexend fonts, which are specifically designed to reduce visual stress and enhance reading performance[7]. Originally created for users with dyslexia and those facing reading difficulties, these fonts feature increased spacing between letters and characters, approximately 35% wider than the average letter width. This decision aligns with the Dyslexia Style Guide[8], which suggests that this spacing significantly improves readability. Additionally, to further facilitate readability, we have set word spacing at 3.5 times the letter spacing, following the recommendations of the Dyslexia Style Guide. In our text, we have chosen to employ the active voice over the passive voice. Our goal is to maintain conciseness and use simple, clear language while avoiding double negatives and abbreviations, as outlined in the Dyslexia Style Guide. We have ensured that all color combinations used feature high contrast to mitigate issues related to color blindness (Hristov et al., 2022). Specifically, Fluffy's colors maintain a strong contrast with the space background, as well as with all the planets they will visit and their spacecraft. In accordance with the Dyslexia Style Guide, we have deliberately avoided color choices that could complicate word recognition for color-blind children, such as green and red/pink. Moreover, we have refrained from using pure white to prevent potential glare and reading difficulties. Instead, we have opted for a dark background to facilitate comfortable reading and reduce strain on children's eyes (Shabbir & Bhatti, 2019). Finally, navigation buttons have been strategically placed to enhance the overall experience for children, taking into account their unique grip and interaction with the device, which may differ from that of adults.

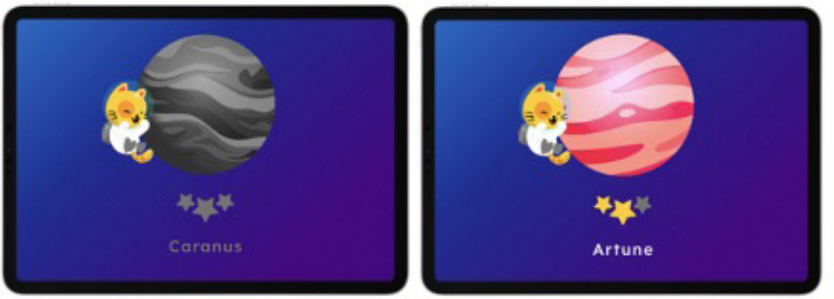
7 https://www.lexend.com

8 https://www.bdadyslexia.org.uk/advice/employers/creating-a-dyslexia-friendly-workplace/dyslexia-friendly-style-guide

Fluffy step by step

Here, we delve into Fluffy in detail, also providing an overview of the level representation. The game begins with a carousel of missions to choose from, each represented by a planet to visit (fig. 1). You can scroll through the missions horizontally, and to enter them, simply press on the desired mission. Available missions are displayed in color, while those that are still locked appear in gray. The next mission unlocks once the previous one has been completed, thus guiding the child through progressively increasing levels of difficulty. Upon completing a level, Fluffy will hold the planet's discovered ball of yarn between his paws. Below the mission description are stars that indicate how well the mission was completed, representing the average of the stars earned in the individual levels (Valenza et al., 2019).

Fig. 1. Example of Fluffy's missions, represented by planets.

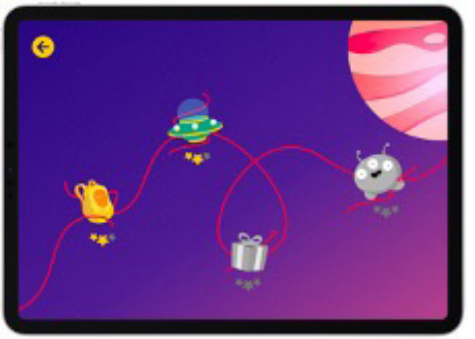


The mission that is not yet unlocked is displayed in gray, while the started mission is colorful. The stars indicate how it is going.

Once the child enters a mission, they will encounter the ball of yarn, which is composed of four levels, progressively increasing in difficulty as the missions progress (fig. 2). The difficulty escalates through adjustments to the game, such as adding more objects or shapes to distinguish, using more or less complex phonemes, or increasing the number of repetitions of the game itself. For example, in the first mission, there are three objects and shapes,

simpler sounds, and the games are repeated five times before moving to the next level. The levels must be completed in order during the first attempt. The mission begins with the backpack level, which involves finding the image that is inconsistent with the others. The second level involves piloting the spacecraft and requires recognizing the correct shape. The third level is the gift exchange level, where players match objects with the same initial sound. Finally, the fourth level involves guiding Fluffy to the ball of yarn, but to do so, the child must follow the directions given by the planet's inhabitants. In this level, the game is to determine whether the words spoken by the inhabitants have similar or different sounds. Depending on the planet, the correct information will involve either similar or different sounds. To return to the mission selection screen, the child can press the arrow in the upper left corner. To enter a specific level, they must press on the sample object. Stars below each level indicate how well it was completed. After completing the levels for the first time and then the entire mission, individual levels can be repeated out of order, allowing the child to practice more on a particular game.

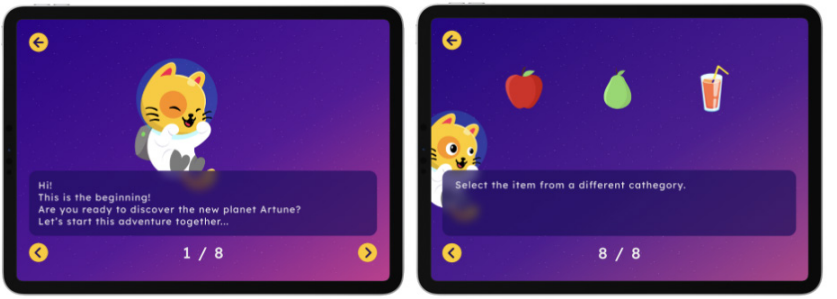
Fig. 2. Selection of levels within the mission. Shaded in gray are the levels not yet unlocked.



Each level has a tutorial before starting to play (fig.3). The tutorial is both written and audio, to facilitate usability depending on the situation (for example, if parents wanted to play it together, they could be the ones to read it) (Valenza et al., 2019). During the tutorial, Fluffy explains what they need

help with: for example, in the first level, Fluffy explains that they need help figuring out which objects to carry or not to carry in space. To do this, you have to select the object that is inconsistent with the others, to exclude it. During the tutorial there is also an explained and participatory example of the game the child will then have to play. For example, in the first level Fluffy shows 3 objects, two fruits and a glass of juice and asks the child to identify the intruder. To move through the tutorial you use the down arrows forward and backward. To return to the level selection, the child must press the arrow in the upper left corner.

Fig. 3. Example of a tutorial screen. Within the tutorial, the child also gets to try the level's game, as can be seen in the second screen.

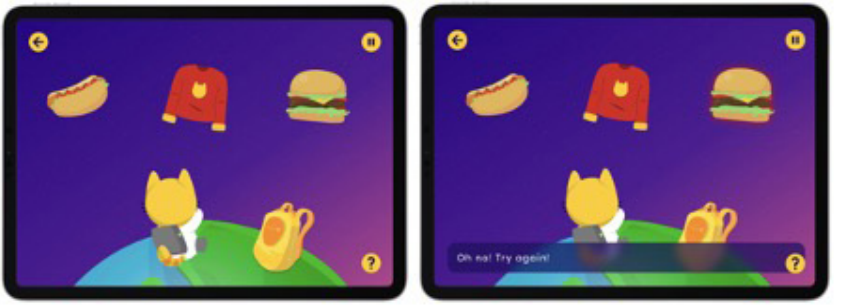


In the first level, Fluffy is still on Earth, preparing for the journey to the selected planet, such as Artune (fig. 4). However, the spacecraft cannot be too heavy, so Fluffy must choose which items to bring and which to leave behind. The game is inspired by the exercise of identifying the image that doesn't fit with the others. For example, it might show 2 buns and a sweatshirt: the sweatshirt doesn't belong, so it should not be packed in the backpack, and so on. This game repeats in a loop for a certain number of times (for example, 5 times in the first mission) before advancing to the second level. To return, the button is always located in the top left corner, and to pause the game, the button is always in the top right corner. Since children may forget how to play the game or need assistance from their parents, we have

included a "?" button that allows them to review the tutorial (Valenza et al., 2019).

The second screen illustrates the scenario where the child makes a mistake: the game doesn't discourage the child in any way and prompts them to repeat the exercise until they choose the correct option. This way, the screening process continues in the background, while the game also encourages the child to improve and practice.

Fig. 4. Example of the first level. The exercise it's based on is the 'recognition of the image that is not coherent with the others'.



In the second level (fig.5), Fluffy has to guide the spaceship by pressing the correct buttons! Fortunately, there is a navigator to assist them and indicate which shape to press. To achieve this, Fluffy must move to the right, center, or left and select the shape that corresponds to the one shown on the spaceship. This game is inspired by the exercise of recognizing the correct shape. The game repeats in a loop for a certain number of times (for example, 5 times in the first mission) before advancing to the next level. To return, the button is always located in the upper left corner, and to pause, the button is always in the top right corner. Since children may forget how to play the game or need assistance from their parents, we have included a "?" button that allows them to review the tutorial (Valenza et al., 2019).

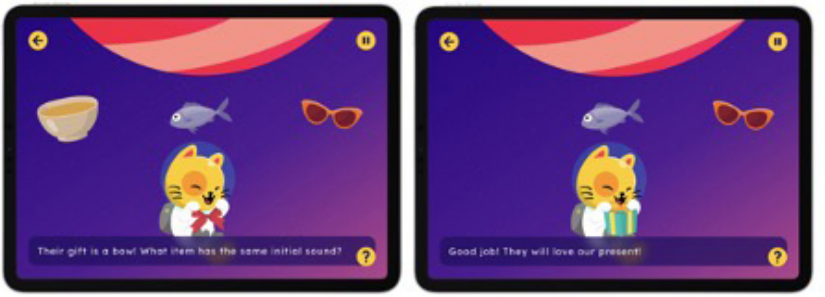
In the third level, Fluffy lands on the planet (fig. 6). As a good guest and to make new interspatial friends, Fluffy has brought gifts to exchange with the planet's inhabitants. To facilitate these

Fig. 5. Example of the second level. The exercise it's based on is the 'recognition of the right shape.' In the second screen, you can see the selection of a shape that needs to be confirmed.

exchanges and be as friendly as possible, Fluffy must match the gifts they receive with those they have to offer. Therefore, Fluffy must respond to the gift they receive with one that shares the same initial sound, choosing from a group of available options. This game is inspired by the exercise of matching images of objects with the same initial sound. The game repeats for a series of times (for example, in the first level, there are 5 gift exchanges) before advancing to the next level. To return, the button is always located in the upper left corner, and to pause, the button is always in the top right corner. Since children may forget how to play the game or need assistance from their parents, we have included a "?" button that allows them to review the tutorial (Valenza et al., 2019).

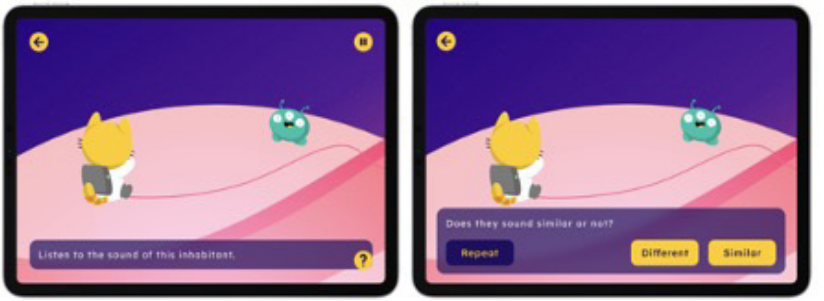
In the final level, Fluffy explores the new planet in search of the ball of yarn to take home. To do so, they seek directions from the planet's inhabitants, who provide both accurate and false information. For instance, on the planet Artune, the correct information is given by the inhabitants who use similar sounds in their responses. The game involves listening to the pairing of two words and determining whether they share similar or different sounds, based on the exercise of distinguishing phonetically similar words. Each time the child correctly identifies the association, the thread gets shorter, and the ball of yarn gets closer.

Fig. 6. Example of the third level. The exercise it's based on is 'matching images of objects with the same initial sound'. In the second screen, you can see the scenario where the correct item has been selected and wrapped for gifting.



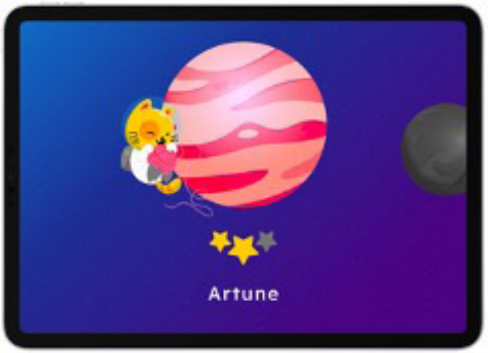
No actual sounds could be included in the prototype, as it was designed in Figma. Examples of interactions can be: 'poor-poor' or 'floor-door.' The game is repeated a number of times (for example, in the first level, there are 5 pieces of information from the inhabitants) before advancing to the next level. To return, the button is always located in the upper left corner, and to pause, the button is always in the top right corner. Since children may forget how to play the game or need assistance from their parents, we have included a "?" button that allows them to review the tutorial (Valenza et al., 2019).

Fig. 7. Example of the fourth level. The exercise it's based on is 'discriminating phonetically similar words,' which are played for listening. In the second screen, you can see how the child must interact to indicate whether the sound is dissimilar or similar.



After completing all four levels, the mission concludes, and Fluffy has found a new ball of yarn to take home with them. The mission can be replayed in its entirety or by individual levels, allowing players to earn more similar balls of yarn that can be used to purchase new space suits for Fluffy. Once a mission is completed, the next one unlocks and is slightly more challenging than the previous one.

Fig. 8. Example of a completed mission. Fluffy holds their reward, a pink ball of yarn.



Conclusion and future works

Fluffy, developed within the #PlaySeriously hackathon, serves as a tangible example of the potential synergy between technology, gaming, and early intervention within the domain of Specific Learning Disorders (SLDs), including dyslexia. This application serves not only as a predictive tool but also actively engages in enhancing the performance of children with dyslexia through an immersive and playful learning process.

Acknowledging SLDs, such as dyslexia, as neurobiological factors affecting learning, underscores the crucial role of timely intervention and effective screening methods. Given that dyslexia is the most prevalent SLD, it can significantly impact a child's self-esteem and academic achievements. Current methods, often expensive and not universally accessible, underscore the pres-

sing need for innovative, all-encompassing solutions.

The utilization of Information and Communication Technologies (ICTs) in dyslexia screening holds promise in delivering cost-effective and readily accessible diagnostic tools. Incorporating game-based interventions (GBI) and game design principles, Fluffy aims to provide an engaging and safe environment for dyslexia prediction and training of people with SLD.

To drive our progress, it is imperative that we continuously explore and refine the implementation of these innovative approaches, both in research and in practical application. By doing so, we can contribute substantially to improving educational experiences and supporting children with dyslexia.

Certainly, there is room for future implementation. We definitely intend to conduct user testing with children to enhance the Fluffy game, optimize the user experience, and ensure the app's effectiveness. These tests will involve, on one hand, children with Specific Learning Disorders (SLDs) within the target age range (between 5 and 7 years) and will be conducted as part of a longitudinal study to detect any improvements over time. On the other hand, validation tests will be performed with professionals who diagnose SLDs to assess the tool's effectiveness and accuracy in prediction. Collaboration with professionals will also lead to the development of a system capable of translating the game's performance into diagnostic assessment. Furthermore, an area dedicated to parents will be designed and subsequently implemented, with a strong focus on communication aspects. Finally, Fluffy - the game will be expanded by adding additional predictive exercises and developed not only as a graphical prototype but as a fully functional and downloadable game aimed at supporting children with SLDs and their families.

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