

Playing to Understand. The Video Game as a Research Laboratory on Media Literacy in Times of Crisis

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Abstract: The Yo-Media – Youngsters’ Media Literacy in Times of Crisis project explores the potential of games as tools for Media and Information Literacy education in times of crisis. The research is grounded in the paradigm of dynamic literacies and the perspective of participatory culture, interpreting play as a space for negotiation and shared meaning-making, and investigating how young people develop knowledge and critical strategies toward digital information. The research protocol consists of four integrated phases: administration of initial questionnaires to teachers and students to assess gaming habits, educational perceptions, and information literacy skills; individual game sessions with the video game Data Defenders; structured observation through a qualitative grid to analyse behaviours, interactions, and cognitive processes during playtesting; and a post-game phase, both individual and group-based, using graphic forms and focus groups to collect reflections and emerging strategies. The data combine quantitative and qualitative perspectives, enabling an integrated interpretation of the relationship between play experience, empowerment, and critical thinking. Preliminary findings indicate increased awareness of informational dynamics, improved source evaluation skills, and greater reflective participation. Yo-Media thus proposes an educational research model in which the video game becomes a laboratory for observing, analysing, and transforming cognitive and social processes related to digital citizenship.



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1. Introduction

Young people today grow up within a rapidly evolving social and communicative environment marked by uncertainty, crises, and structural transformations that are widely represented - and often amplified - within contemporary media systems. In this context, the development of *dynamic literacies* (Potter & McDougall, 2017) has become a crucial condition for orienting oneself in complex information ecosystems and for identifying misleading or false content, especially when news circulation increasingly

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takes place through algorithmically driven and weakly mediated social platforms (Lauricella, Herdzina & Robb, 2020; Krumsvik, 2023; Santos, Gonçalves & Teles, 2023).

Concerns regarding the distortion of information and its impact on democratic life are far from new. Since the early twentieth century, scholars from different disciplinary traditions have drawn attention to the strategic manipulation of public opinion in times of conflict and social instability. Historical research, such as Marc Bloch's (1921) analysis of misinformation during the First World War, alongside contributions from communication sociology and political analysis - ranging from Walter Lippmann's (1922) reflections on public opinion, to Harold Lasswell's (1927) studies of political communication - have consistently highlighted how media systems tend to deviate from their democratic function during periods of crisis (Mannheim, 1940). In such moments, persuasive and manipulative communicative strategies intensify, aiming to influence individual behaviors and reshape social relations (Gili, 2001). The persistent suspicion surrounding media credibility, historically embedded in specific socio-political contexts, provided fertile ground for the emergence of Media Literacy Education in the second half of the twentieth century, initially grounded in the promotion of critical thinking skills (Carenzio, Ferrari, in print).

The transition to the contemporary digital environment - conceptualized by Floridi (2014) as the *infosphere* - has further challenged this educational framework. Media Literacy Education today is increasingly required to move beyond a sole focus on critical media consumption and to incorporate dimensions related to media production and participation. This shift implies an educational emphasis on responsibility, understood as the capacity to anticipate and evaluate the social consequences of one's communicative actions within networked environments. Such a perspective is particularly relevant in addressing and preventing behaviors associated with what has been defined as "cyber stupidity" (Prensky, 2010). In this scenario, individuals are no longer positioned merely as audiences resisting manipulation, but as active *prosumers* (Toffler, 1980), simultaneously producing, circulating, and interpreting content. This transformation has significant implications for Information Literacy (Ferrari & Pasta, 2023). One of the defining characteristics of the digital age is not simply the abundance of information, but the qualitative changes in how information is organized, accessed, and legitimized. The central challenge is no longer the retrieval of sources, but their critical evaluation. Digital navigation is characterized by information overload, fragmentation and decontextualization, continuous mutability of content, non-linear and unpredictable pathways enabled by hyperlinks, and fluctuating criteria of authority that complicate traditional classification systems. This task becomes particularly urgent during periods of crisis, as evidenced in recent contexts such as the war in Ukraine and in the Middle East, but also in the protests marking ICE's intervention in Minneapolis (in January 2026).

In particular, the perspective we adopt conceptualizes literacies as elements that interact with socio-cultural contexts, with the practices of individuals and communities, and with meaning-making processes. This entails recognizing the strong relationship of reciprocity and co-evolution linking modes of expression, competencies, practices, and contexts, drawing on analyses that define literacies as situated and distributed. This perspective acknowledges the concreteness of literacies and their connection to the shared meanings produced by people: texts and discourses are not "abstract entities" conformed to predefined textual models, but authentic construc-

tions, created in response to specific situations encountered in everyday life (Cisotto, 2006).

Besides this, another framework is crucial, that is the *dynamic literacies* perspective (Potter & McDougall, 2017). Underlying this concept is a flexible and continuously evolving approach to literacies: literacy goes beyond the mere ability to read and write - once and for all - languages and formats, and instead exists as an ongoing process that adapts to the technological, cultural, and social changes associated with media. Literacies, therefore, cannot be confined within a static logic, but are progressively constructed through diverse practices within a complex media ecosystem.

Within this broader framework, video games have gained renewed scholarly and educational attention, especially following the COVID-19 pandemic, which highlighted their potential role in supporting psychological well-being and social connectedness (Cauberghe et al., 2021; Kriz, 2020; Ohannes et al., 2021). These experiences have encouraged educators and practitioners to explore game-based approaches as tools for fostering Information Literacy among young people. Through narrative immersion, identification processes, interactivity, productive failure, and strategic problem-solving transferable beyond the gaming context, games and video games can foster forms of critical, participatory, and reflective engagement with media content (Moro et al., 2022, Pelizzari, 2025).

Digital games can function as environments for critical learning by fostering players' reflexive awareness of the systems, representations, and logics embedded within them (Bunt & Grosser, 2020; Mao et al., 2022). This reflective stance enables players to better understand how media shape interpretations of reality and how social and cultural contexts influence the way problems are perceived and framed (Gee, 2003).

It is within this theoretical and educational landscape that the Yo-Media-Youngsters' Media Literacy in Times of Crisis project was developed. Funded by the European Media and Information Fund, established by the European University Institute and the Calouste Gulbenkian Foundation, the project aimed to respond to these challenges through the design and implementation of board games and a video game specifically addressing misinformation and disinformation, as well as the development of skills in crisis contexts. Here, video games function as a setting for fostering competencies, while also serving as a tool for conducting research with young people. In this respect, the present contribution seeks to offer a focused intervention through the presentation of the usage protocol for the game Data Defenders, one of the digital artifacts designed within Yo-Media.

2. Theoretical Framework

A growing body of research has highlighted the educational potential of video games as environments capable of supporting learning, engagement, and critical reflection. A foundational contribution in this field is provided by Gee (2003; 2007), who identifies a set of learning principles embedded in well-designed video games, including situated meaning, identity exploration, immediate feedback, productive failure, and iterative problem solving. From this perspective, video games do not merely convey content, but structure learning experiences in which knowledge is constructed through action, decision making, and reflection on consequences (Shute & Ventura, 2013).

From an educational standpoint, video games can be understood as complex environments that integrate different dimensions of learning (Juul, 2005; Squire, 2011). They operate simultaneously as narrative environments, rule-based systems, and problem-solving contexts (Barr & Copeland-Stewart, 2022). As narrative spaces, games immerse players in symbolic worlds that provide context, meaning, and emotional engagement. As systems of rules, they require players to interpret constraints and understand causal relationships (Kowert, 2020). As problem-solving environments, they demand continuous hypothesis testing, strategic planning, and adaptation to feedback (Granic, Lobel, & Engels, 2014).

These characteristics make video games particularly relevant in contemporary contexts marked by crisis and uncertainty. During periods of social, health, or environmental crisis, research has shown that video games can support engagement, emotional regulation, and social connection (Cauberghe et al., 2021; Kriz, 2020; Ohannes, Vuorre, & Przybylski, 2021). Beyond their role in well-being, games offer structured spaces in which complexity, risk, and uncertainty can be simulated and explored without real-world consequences (Bowman & Banks, 2021). This aspect is particularly significant for educational interventions aimed at developing critical competencies such as Media and Information Literacy (MIL), where learners are required to navigate ambiguous information, conflicting perspectives, and rapid decision-making processes.

Within this framework, it is crucial to distinguish between two complementary but conceptually distinct uses of video games in educational research (Alonso-Fernández et al., 2019).

- On the one hand, the educational use of video games refers to the intentional integration of games into teaching and learning processes, with the explicit aim of fostering knowledge, skills, and attitudes. In this sense, games function as pedagogical tools designed or selected to support learning objectives, motivation, and engagement. Research in this area has explored how games can enhance understanding, collaboration, and problem solving, as well as how they can be aligned with curricular goals and assessment practices (Cerezo-Pizarro et al., 2023).
- On the other hand, and more centrally for the present study, video games can be conceived as instruments of educational research. From this perspective, the game is not only a medium for learning, but also a methodological device that enables the observation and analysis of cognitive, strategic, and reflective processes as they unfold in action. Because games require players to make decisions under constraints, interpret information, manage resources, and respond to feedback, they generate rich behavioral data that can be systematically observed and analyzed. This shifts the focus from what learners say they know or believe, to what they actually do when confronted with complex, dynamic situations (Mitchell & Van Vught, 2024).

In this sense, video games function as situated environments in which competencies such as critical thinking, information evaluation, and decision making become observable through gameplay (Deng et al., 2023). The iterative structure of games—based on cycles of action, error, feedback, and adaptation—creates conditions that are particularly conducive to the study of reflective processes. The following

sub-sections build on this assumption by focusing respectively on experiential and transformative learning, narrative and agency, collaborative dimensions, and critical reflexivity in relation to video game-based educational practices.

2.1 Video Games as Experiential and Transformative Environments

One of the fundamental principles is experientiality, which refers to learning as an active construction grounded in lived experience. Following David Kolb's model (1984), the experiential learning cycle is articulated in four phases: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Video games potentially allow learners to move through all these phases, offering environments in which adults can act, observe, reflect, and meaningfully re-elaborate their experiences (Farber, 2021). More specifically, game environments enable the exploration of symbolic situations with high emotional density, through which adults can engage with realistic, alternative, or dystopian scenarios, assume different roles, make ethically charged decisions, and reflect on the consequences of their actions (Rusch, 2020). The possibility of making mistakes without real-world risks, reworking those mistakes, and trying again fosters deep and long-lasting learning (Kiili, 2005).

According to Mezirow (2003), transformative learning is triggered when adults encounter a disorienting dilemma, a situation that challenges their existing meaning perspectives. Many complex, narrative-driven games—such as *This War of Mine*, *Papers, Please*, or *Life is Strange*—generate precisely this kind of dissonance, stimulating critical reflection on one's own standpoint and promoting a redefinition of the self and of one's relationship with the world (Smethurst & Craps, 2015; Formosa et al., 2016).

2.2 Narrative, Identity, and Agency

The second foundational principle is narrativity, understood not merely as the presence of a story, but as the opportunity for adults to construct an identity discourse through play (Murray, 1997). Video game narratives are dynamic, interactive, and often branching: players make choices that alter the trajectory of the story, shaping a personal and subjective narrative (Bessiere et al., 2007). In this dimension, narration intertwines with self-construction: adults experiment with unfamiliar roles, explore identity possibilities, make moral decisions, and confront ambiguity (Passmore & Mandivarapu, 2022).

Bruner (1990) and Ricoeur (1991) remind us that identity is narratively constructed: telling one's story is a way of giving oneself form, reflecting on lived experience, and negotiating meaning. When designed and used within an educational framework, video games can therefore become narrative technologies that enhance adults' capacity for self-inquiry, engagement, and the development of new forms of personal and social awareness (Kühn & Gallinat, 2021).

Closely connected to narration is the principle of agency, that is, the player's capacity to exercise meaningful control over the game world. Agency entails responsibility, choice, and action with consequences (Schrier, 2021). In well-designed games, player decisions are not merely instrumental to scoring, but acquire ethical and relational significance (Vella, Johnson & Hides, 2019). This stimulates reflection and strengthens intrinsic motivation (Ryan & Deci, 2000) as well as perceptions of

self-efficacy (Bandura, 1997), both of which are key dimensions in adult learning processes (Przybylski, Rigby, & Ryan, 2010).

2.3 Collaborative Learning and Gaming Communities

Another central methodological principle is collaboration. In cooperative games, multiplayer environments, or participatory serious gaming contexts, the gaming experience becomes an opportunity to practice relational skills, coordinate actions, and negotiate roles and objectives (Steinkuehler, 2006). Games foster the development of social competences—effective communication, conflict management, empathy—that are fundamental to any lifelong learning pathway (D'Angelo & Kaye, 2024).

The theoretical reference here is the socio-constructivist perspective (Vygotsky, 1978; Lave & Wenger, 1991), according to which learning always occurs in relation to others and to the context. Digital games, especially when embedded in facilitated educational settings, can activate communities of practice (Wenger, 1998), understood as contexts in which languages, rules, and meanings are shared. The participatory culture that develops around many gaming experiences (modding, fan fiction, collaborative walkthroughs, forums) represents fertile ground for connective and dialogic learning (Ito et al., 2013; Jenkins et al., 2016).

2.4 Symbols, Ideologies, and Critical Reflexivity

Finally, a key—and often underestimated—principle is critical reflexivity. Video games are not neutral: they convey worldviews, models of society, and representations of gender, power, ethnicity, and normality (Pfister, 2021). Adult education has the task of fostering conscious analysis of these contents, encouraging a deconstructive and critical approach (Giroux, 2004; Hobbs, 2021).

Using video games as a method also means engaging in media education, that is, providing tools to interpret, analyze, and redefine the meanings proposed by digital media (Garcia, 2020). Post-game reflexivity, through activities such as discussion, writing, and re-elaboration, can transform the gaming experience into an emancipatory cultural practice, capable of activating processes of critical literacy, cognitive empathy, and conscious participation (Bogost, 2007; Flanagan, 2009).

As Maria Pavlou (2020) emphasizes in her model of Game-Informed Playful Assessment, play can become a lens through which to read the dynamics of the self, relationships, and social institutions, activating processes of authentic and transformative assessment oriented toward the development of personal and collective competences.

3. The project Yo-Media

3.1 The Yo-Media project

Yo-Media (<https://yomedia.a-mcc.eu/>) is a three-year forward-looking initiative funded by the European Media and Information Fund established by the European University Institute and the Calouste Gulbenkian Foundation (project n. 269094), with a strong emphasis on enhancing media literacy among young individuals, par-

ticularly during times of crisis (health emergencies, war crises, and natural catastrophes).

The consortium was composed of the Associação Portuguesa de Imprensa, the Media Competence Center di Aveiro, the Universidade de Aveiro, of the Catholic University of Milan, and the Universitat de Vic - Central de Catalunya.

This project - completed in 2025 - aimed to map Media and Information Literacy practices in times of crisis by identifying patterns of behaviour on social networking platforms, through content and pragmatic analyses of media programs and educational initiatives, and interviews with stakeholders, focusing on pedagogical practices for the delivery of school education and media literacy training across diverse linguistic and sociocultural contexts.

The main idea was to support a deeper understanding of reader–producer behaviours, particularly with regard to fact-checking practices and attitudes towards media during periods of crisis. Finally, the initiative sought to enhance users' understanding of online platforms by addressing the functioning of algorithms, recommendation systems, content classification processes, and the use of personal data, while also strengthening the Southern European network in Media Literacy Education.

Five phases have been planned: (1) Map video games and games related to the topic of military, sanitary, environmental crises (Carenzio, 2024; Contreras-Espinosa et al., 2024); (2) Explore the connection between video games and MIL in times of crisis, through literature analysis and semi-structured interviews with educators and teachers in Italy, Portugal, and Spain (Carenzio et al., 2024); (3) Develop and validate games (two board games and a video game²). In particular, the consortium designed three ludic artifacts. The first is Social Media Puppeteers, a micro TTRPG (tabletop role-playing game) adapted and customized to create an educational experience focused on media literacy, critical thinking, and social media dynamics. The target audience is 11-17 years old. Players assume the roles of politicians, journalists, scientists, or influencers, competing on a fictional social media platform to gain influence and promote media literacy. During the game, players earn points when they achieve certain objectives or goals related to their character's role and special abilities. The second is Social Media Fake News, a card game designed to help players understand the features that can make a news story vulnerable and false. The goal is to be the first to run out of cards by constructing a fake news story. It is divided into news construction cards with striking headlines, emotional language, references for your story, polarizing phrases, and action cards that allow for strategic counterattacks on the news, causing opponents to eat their words. This card game is designed for 2 to 6 players, although it is recommended to have more than two. The components required to play include a board, News Construction Cards, Action Cards, and Counterattack Cards, with Topic Cards being optional; (4) Design and deliver a MOOC on information literacy in times of crisis (Ferrari & Merigo, 2026). The MOOC (a four-module course) is aimed at teachers, educators, and journalists. Module 1 makes participants understand the framework of information literacy today, especially in times of crisis, helping them to understand the main issues and support self-training and continuous learning. Module 2 starts from the main findings of Yo-Media, translated into practical resources, suggestions, examples, good practices, and ideas to

² On Internet: URL https://yomedia.a-mcc.eu/wp-content/uploads/2024/12/Booklet_YO-MEDIA_v02-1.pdf

be used at school and in education contexts. This module also includes a discussion of peer-to-peer strategies to engage students, educators, and teachers. Module 3 goes into depth presenting the video game, suggesting how to use video games in education and training. Module 4 focuses on the board game developed by the Yo-Media partners and includes video supporting the use of board games in education and training; (5) Assess the feasibility of the strategies adopted.

3.2. Data Defenders: Game Design Oriented to Media and Information Literacy

Data Defenders³ is a mobile video game designed in the tower defense genre (Palos-Sánchez et al., 2024). This choice was made not only for reasons of accessibility and immediacy (short sessions, understandable rules, level progression), but especially because, by its nature, this genre requires players to make decisions under constraints: allocating limited resources, anticipating scenarios, evaluating trade-offs between alternative actions, and adapting strategy according to continuous feedback from the game system (Soares et al., 2023). From this perspective, tower defense becomes a suitable device to stage—through a system of rules and consequences—typical processes of critical reasoning and information management, consistent with the view of video games as environments where “learning happens by doing,” through cycles of hypothesis, trial, error, and adjustment (Belyaev et al., 2025).

Figure 1. Data Defender - Home Page



Data Defenders’ setting is constructed as a systemic metaphor for contemporary crises. The narrative stages simultaneous threats (e.g., alien invasion and pandemic) distributed across islands/territories to defend, each with a key character linked to the information ecosystem (journalist, politician, influencer).

This choice is not merely aesthetic: the co-occurrence of crises and threats acts as intentional “pressure” on the player, making the experience plausible in relation to a central trait of today’s information contexts—namely, the necessity to make rapid

³ On Internet: URL <https://yomedia.a-mcc.eu/game/>

choices under conditions of uncertainty and overload (Soriani, 2024). In terms of Media and Information Literacy (MIL), this recalls the idea that competence does not coincide with a declarative repertoire of notions, but rather with a set of operational skills that allow one to access, understand, evaluate, and use information consciously.

The player assumes the role of defender of global data servers and acts in a world where information circulation is part of the conflict: it is not just about repelling “enemies,” but about protecting symbolic and material infrastructures of the public sphere (data, networks, credibility).

The presence of characters (journalist, politician, influencer) helps to make visible the social and institutional dimension of information, emphasizing that information quality depends on different actors, logics, and interests. In this direction, the game constructs a framework consistent with an “ecological” approach to literacy, considering information practices as situated and intertwined with platforms and contemporary cultural dynamics (Muriel & Crawford, 2020).

The game design integrates three core mechanics that, together, orient the experience toward media literacy processes.

(a) Data Analyzer: Evaluating Content, Credibility, and Bias

The distinctive feature is the Data Analyzer, a mechanic that allows players to analyze media content to verify credibility and detect possible biases. From an educational standpoint, the Data Analyzer functions as a “micro-device” of evaluation: it interrupts the automatism of action and asks the player to perform an interpretive step. This recalls central practices in contemporary information literacy: checking the source, contextualizing, identifying manipulation signals, distinguishing evidence from opinion, and recognizing distortion elements. This aligns with studies on civic online reasoning and expert strategies for evaluating digital information (Domsch, 2013).

(b) Resource Management: Constraints, Priorities, Trade-offs

As in many tower defense games, managing time and resources (placement of defenses, optimization, choice of upgrades) forces players to explicitly state priorities and criteria: it is not possible to “do everything.” This aspect is particularly relevant because it simulates—on a playful level—a key trait of real information contexts: attention is limited, time is scarce, choosing a source/action implies giving up alternatives. In terms of learning, the game brings out observable and traceable decisions, consistent with the idea of integrating evaluation in situ (embedded/stealth assessment) through behaviors and performance in gameplay (Bódi, 2023).

(c) Information Evaluation as Action with Consequences

A crucial design point is that information evaluation does not remain an “external” discourse to the game, but takes the form of an action that produces effects on the system (Bonner et al., 2022): verifying (or not verifying), correctly interpreting (or misunderstanding), recognizing bias (or ignoring it) has consequences on the game’s development. This approach is consistent with the perspective of proceduralism: video games argue and make systems understandable through rules and simulations, allowing players to “think” within an operational model of the phenomenon (procedural rhetoric)

Figure 2. Data Analyzer



The guiding hypothesis of Data Defenders is that specific mechanics—when integrated coherently between theme, rules, and feedback—can activate processes of information literacy and reflective decision making, making them necessary for success in the game and thus more easily observable and discussable in post-game debriefing. This hypothesis is based on three main assumptions:

1. Learning as participation in practices: information literacy develops when the subject acts in tasks requiring selection, evaluation, and use of information, not only when discussing it abstractly (Hart & Laurs, 2021).
2. Video games as problem-solving environments and operational identities: good video games promote cycles of hypothesis–action–feedback, support situated learning, and encourage players to reflect on choices and consequences (Chen et al., 2020).
3. Integrated evaluation and reflection: when the game incorporates moments to pause, analyze signals, choose criteria, and justify decisions (e.g., through the Data Analyzer and resource constraints), it becomes possible to connect gameplay performance to reasoning processes, in line with integrated assessment approaches in gameplay (Davis & Fullerton, 2021).

Data Defenders does not use the crisis framework and information ecosystem merely as a narrative scenario, but transforms them into operational conditions: the player is prompted to treat information as a strategic resource, recognize signals of reliability and distortion, and make more conscious decisions because these decisions are “put to the test” by the game system (Loh & Sheng, 2020).

The mechanics were not designed solely as playful elements, but as observable devices capable of making explicit and analysable the cognitive and decision-making processes linked to Media and Information Literacy. In this perspective, the Yo-Media research protocol was constructed in coherence with the game design,

structuring tools and phases capable of capturing the actions, strategies and reflections activated by gameplay.

4. Methodology and Tools

4.1 Research design

The study adopts an exploratory mixed-methods research design (Creswell & Plano Clark, 2025), aimed at analysing in an integrated way the cognitive, decision-making and reflective processes activated by the gameplay experience with Data Defenders in relation to Media and Information Literacy (MIL), empowerment and critical thinking.

The choice of a mixed-methods approach responds to the need to address an intrinsically complex and multi-level object of study: the educational gaming experience. In this context, the competences investigated do not manifest themselves solely as measurable outcomes or subjective statements, but as situated processes that emerge in action, in the strategies adopted, in reactions to system feedback and in subsequent reflective re-elaborations. For this reason, an exclusively quantitative or exclusively qualitative approach would be partial. The mixed-methods design makes it possible to:

- describe participants' profiles, reported practices and self-perceptions through quantitative instruments;
- observe and interpret in-situ behaviours, game strategies and decision-making processes through qualitative data collected during gameplay;
- integrate these levels of analysis within a triangulated perspective, strengthening the interpretive validity of the results.

The exploratory nature of the design is consistent with the nature of the research, which does not aim to test predetermined causal hypotheses, but to investigate the potential of the video game as an educational research laboratory, capable of making practices of media literacy and reflective decision making observable in authentic action contexts.

The methodological rationale is based on the assumption that competences such as MIL and critical thinking cannot be fully understood through exclusively self-report instruments, which tend to capture representations and subjective perceptions, but not necessarily actual behaviour. These competences instead require in-situ observation in order to analyse how individuals evaluate information, manage resources and make decisions under constraints and through moments of guided reflection, to make explicit the implicit processes activated during the gameplay experience.

From this perspective, the video game Data Defenders is not considered only as an object of study, but as a structured environment for data production, in which participants' actions—choices, errors, adaptations, strategies—become observable indicators of cognitive and metacognitive processes that would otherwise be difficult to access. The integration of questionnaires, observations, graphic tools and focus groups therefore enables methodological triangulation that strengthens the robustness and depth of the analysis.

Throughout the protocol, researchers assume differentiated but complementary roles: coordinators of the procedure, observers during gameplay, facilitators of

post-game reflection (Gentles et al., 2020). In all operational phases, a methodological stance is maintained that is consistent with the research objective: minimising external influence on participants' choices while ensuring clarity, organisational support and data-collection quality. This procedural care strengthens the ecological validity of the study and makes it possible to interpret the Data Defenders experience as an authentic context for the activation and observation of the competences under investigation.

4.2 Participants and context

The research was conducted in two upper secondary schools, involving 73 students aged between 15 and 18. The choice of this school level is not accidental, but responds to specific theoretical and methodological considerations.

The school context therefore constitutes a privileged space for observing media literacy practices in formation, in which competences, attitudes and informational strategies are still being consolidated and are particularly sensitive to intentional educational experiences.

All students in the groups took part in the initial phase of completing the student questionnaire, which had a twofold function: on the one hand, to collect descriptive data on gaming and informational practices; on the other, to provide the basis for selecting participants for the observed gameplay phase.

On the basis of the responses collected, 5–6 students per class were selected for the gameplay session with Data Defenders. The selection did not follow random criteria, but a purposive sampling logic, aimed at ensuring maximum heterogeneity of the profiles observed. In particular, the selection criteria included:

- Level of gaming experience, distinguishing between expert players, occasional players and students with little or no video game experience
- Gender representation, in order to avoid over-representation of specific profiles and to observe any differences in ways of interacting with the game.

This strategy made it possible to explore different ways of approaching the video game, preventing the results from being strongly influenced by pre-existing technical skills and allowing observation of how game design activates reflective processes even in non-expert participants.

Class teachers played a dual role within the research. On the one hand, they took part in data collection by completing a specific questionnaire designed to explore pedagogical representations of games and video games, perceptions of educational effectiveness and perceived opportunities and critical issues in integrating playful strategies into teaching.

On the other hand, teachers helped to contextualise the gameplay experience within students' educational pathways, offering a pedagogical perspective that complements that of the participants. This dual contribution makes it possible to interpret the Data Defenders experience not only from students' point of view, but also in light of the real conditions of educational implementation, thereby strengthening the relevance and transferability of the results.

4.3 Tools

4.3.1 Student questionnaire

The student questionnaire has a twofold function: (a) a descriptive function, as it reconstructs participants' gaming profile and some self-reported practices/skills related to information management; (b) a sampling/selection one, because it makes it possible to identify 5–6 participants per class with differentiated profiles (expert, occasional, non-players) while ensuring balanced to gender representation.

The instrument is organised into blocks consistent with the constructs of the study:

1. Socio-demographic data and informed consent (including the creation of a unique ID code for anonymisation).
2. Practices of searching and selecting sources: ways of searching online, criteria for choosing sources, behaviour when faced with a doubtful/false piece of news.
3. Basic knowledge of copyright (closed-ended items).
4. Gamer profile: frequency, devices, times and contexts of play, favourite genres, social dimension (playing alone/in a group, online/offline).
5. Collaboration and communication (perceptions of the impact of video games on interaction, negotiation, teamwork, belonging to communities) (Likert scale 1-6).
6. Empowerment (self-esteem, perseverance, stress management, sense of control, confidence in decisions) (Likert scale 1-6).
7. Problem solving and critical thinking (strategic thinking, trying alternative solutions, planning/organising actions, managing time and resources) (Likert scale 1-6).
8. Self-perception of competences developed through gaming (selection of 4 competences from a set) and characteristics of video games perceived as useful for school learning (selection of 4).

The sections on online search, criteria for choosing sources, fake news and copyright capture operational dimensions of information literacy/MIL (access, selection, evaluation and responsible use of information).

The scales on empowerment and problem solving are consistent with the demands of tower defense games (resource management, planning, adapting to error), while the collaborative dimension provides background information useful for interpreting possible reflections on strategies and peer comparison (in focus groups).

The questionnaire allows: (a) descriptive analyses (frequencies, means); (b) construction of indices/scales (e.g. empowerment, collaboration, problem solving/critical thinking) for exploratory comparisons between gaming profiles; (c) variables useful for interpreting differences in strategies observed in play (e.g. experience, gender, preferences for game genres).

4.3.2 Teacher questionnaire

The teacher questionnaire gathers the “pedagogical perspective” on games/video games: familiarity, attitudes, perception of effectiveness and critical issues in educational integration.

It provides an essential interpretive context for understanding the Data Defenders trial not as an isolated episode, but within school representations and constraints (time, assessment, classroom management, resources). The instrument, adapted from Andreoletti and colleagues (2024) includes:

1. Socio-professional data (age ranges, educational qualification, years of service, disciplinary area).
2. Personal gaming experience (in the last six months: board game/video game/no experience).
3. Perceived educational effectiveness of games and video games with respect to types of knowledge (factual, conceptual, procedural, metacognitive).
4. Perceived educational opportunities (selection of priorities: motivation, problem solving, collaboration, critical thinking, etc.).
5. Perceived critical issues in classroom introduction (multiple selection: choice of titles, time, assessment, classroom management, resources, alignment with objectives, etc.).
6. Didactic functions attributed to games (motivational, socialising, experiential, assessment-related, personalised, etc.).
7. Scalar evaluations of the impact of playful strategies on a wide range of dimensions (e.g. concentration, planning, anticipation, evaluation of information, critical thinking), and on the contribution to key competences and areas of development (self-regulatory/metacognitive, motivational, etc.).

The items on “evaluation of information”, critical thinking, decision making and planning make it possible to relate the potential attributed by teachers to what emerges in practice (in-game observation + post-game reflections).

The critical issues and didactic functions help interpret any gaps between perceived potential and real conditions of implementation (time, assessment, resources).

4.3.3 Observation grid during playtest

The grid is the key tool of the qualitative “in situ” component.

It is derived from playtesting observation practices (typical of game design), but used for educational purposes: it is intended not only to determine whether the game functions effectively, but to record strategies, decision-making processes, error management and information evaluation practices as they emerge during play. In line with the protocol, the grid focuses on:

1. Game strategies (planning, anticipation, strategy changes, responses to waves/threats).
2. Resource management (allocation, priorities, trade-offs, time).
3. Use of the Data Analyzer (when it is activated, how often, at which “critical” moments in the game, and how it influences subsequent choices).

4. Errors, feedback and self-regulation (how the player interprets failure, whether strategy is modified, whether the player perseveres or gets stuck).

The protocol recommends an observation ratio of 1:1 or 1:2 (one observer per student or per two students), to minimise the loss of micro-behaviours and spontaneous verbalizations (e.g. comments about “checking information”). The data are then subjected to qualitative analysis (grounded/thematic coding) to bring out recurring patterns and strategies.

4.3.4 Individual graphic feedback sheet

The graphic feedback sheet is completed immediately after the game session and aims to collect self-reported data on the gameplay experience, in a visual form that facilitates the recall of decisions and feelings (control, planning, pace, luck, meaningfulness of choices) (Antle et al., 2024). The sheet yields indicators useful for connecting gameplay and constructs:

1. Understanding of objectives (when the player “understands what they are doing” with respect to the levels).
2. Agency and sense of control (perception of being able to influence the outcome).
3. Meaningful decisions (perception of choices with consequences).
4. Pace and duration (perceived speed, moments of inactivity).
5. Coherence between mechanics and theme, and meaningfulness of rules.
6. Planning (continuous vs global strategy).
7. Role of luck.
8. Overall evaluation also through a concise description (one word).

The sheet allows immediate triangulation: what the researcher observes (strategies, errors, use of the Data Analyzer) can be compared with what the student perceives (control, planning, meaningfulness).

It is particularly relevant for reading empowerment (agency), reflective decision making (planning, evaluation of consequences) and engagement.

4.3.5 Post-game focus group

The focus group is conceived as a guided reflective device for re-elaborating the experience, with the aim of bringing out (a) strategies and reasoning; (b) interpretations of the role of information in the game; (c) awareness that can be transferred outside the playful context. Methodologically, the focus group acts as a mechanism for 'double-loop learning' (Argyris, 1976). It allows participants to move beyond correcting immediate errors (single-loop) to questioning the underlying assumptions that guided their in-game strategies. By verbalizing their tacit knowledge—why they prioritized one source over another under pressure—students transform ephemeral gameplay intuitions into consolidated cognitive schemas transferable to real-life information behaviors.

It is also a space where MIL can be observed as discursive and reflective practice, not only as performance. The guided discussion (audio-recorded) typically focuses on:

1. Objectives and mechanics: key moments, obstacles, difficulties.

2. Decisions and strategies: key choices, strategy changes, error management.
3. Information literacy and learning: how information is evaluated, how uncertainty is managed, perceived usefulness outside the game.
4. Critique and improvement of the game (indications also useful at design level).
5. Self-assessment of competences: selection of competences and justification (e.g. planning, stress management, problem solving).

The protocol requires a moderator and a note-taker/transcriber (non-interventionist), with mandatory audio recording, in order to safeguard data quality and interpretive fidelity.

Taken together, the tools operationalise the constructs in a complementary way:

- MIL is captured as practice (student questionnaire), as behaviour (grid: use of Data Analyzer/strategies) and as reflection/argumentation (focus group).
- Empowerment is read through self-perceptions (student scale; feedback sheet: control/decisions) and through indirect signals in gameplay (perseverance, error management, adaptation).
- Critical thinking/reflective decision making is analysed as the ability to evaluate alternatives and consequences (observation), to plan and manage constraints (observation + sheet), and to justify/argue strategies (focus group).

4.4 Procedure

The research protocol is structured into four integrated and sequential phases, designed to progressively guide participants from initial activation to reflective re-elaboration of the gameplay experience (Mertens, 2020). This procedural articulation responds to a twofold need: on the one hand, to ensure the systematic collection of heterogeneous data (quantitative and qualitative); on the other, to support a coherent path of experience–observation–reflection, in line with the idea of the video game as an educational research laboratory.

Phase 1. In-class session: activation and initial data collection

The first phase takes place in the classroom and lasts approximately 20–30 minutes. It is dedicated to introducing the research and administering the questionnaires to students and teachers. The session begins with a brief presentation by the researcher aimed at presenting the overall aims of the study, clarifying participation procedures and providing information on privacy protection, anonymity and data processing.

Subsequently, the student questionnaire is administered to all pupils in the class, while teachers complete their own dedicated questionnaire in parallel. This phase makes it possible to collect fundamental background data (gaming profile, informational practices, self-perceived competences, pedagogical representations), which form the basis both for quantitative analysis and for the subsequent qualitative phases.

From a methodological standpoint, this phase has a contextualising function: it situates the gameplay experience within participants' prior practices and perceptions, preventing observed behaviours from being interpreted as isolated events.

Phase 2. Identification of participants: purposive selection

The second phase consists of analysing the student questionnaires and selecting participants for the observed gameplay session. This phase does not involve the students directly, but is carried out by the researchers. On the basis of the responses collected, 5–6 students per class are selected for the gameplay session, following purposive sampling criteria: level of gaming experience (expert players, occasional players, non-players) and gender representation.

This phase is crucial to ensure heterogeneity in the observed sample and to avoid interpreting the gameplay experience solely in light of pre-existing technical skills. From a procedural perspective, the selection already anticipates an analytical logic, oriented towards comparing different approaches, strategies and decision-making processes.

Phase 3. Gameplay session: in-situ observation

The third phase represents the empirical core of the protocol and is dedicated to the individual gameplay session with Data Defenders. Each participant plays for about 30 minutes using a mobile device, in a controlled but not artificial setting.

During gameplay, one or more researchers/observers complete the qualitative observation grid, with a recommended ratio of 1:1 (one observer per student) or 1:2 (one observer every two students), in order to ensure a high degree of observational granularity. The observer's role is precisely defined:

- systematically observe game strategies, use of the Data Analyzer, resource management, and reactions to errors and system feedback
- note any spontaneous verbalizations
- refrain from intervening during gameplay, avoiding suggestions or corrections that could influence the player's decisions.

This phase makes it possible to collect data on decision-making processes and information-literacy practices in action, overcoming the limitations of self-report tools and making situated competences observable.

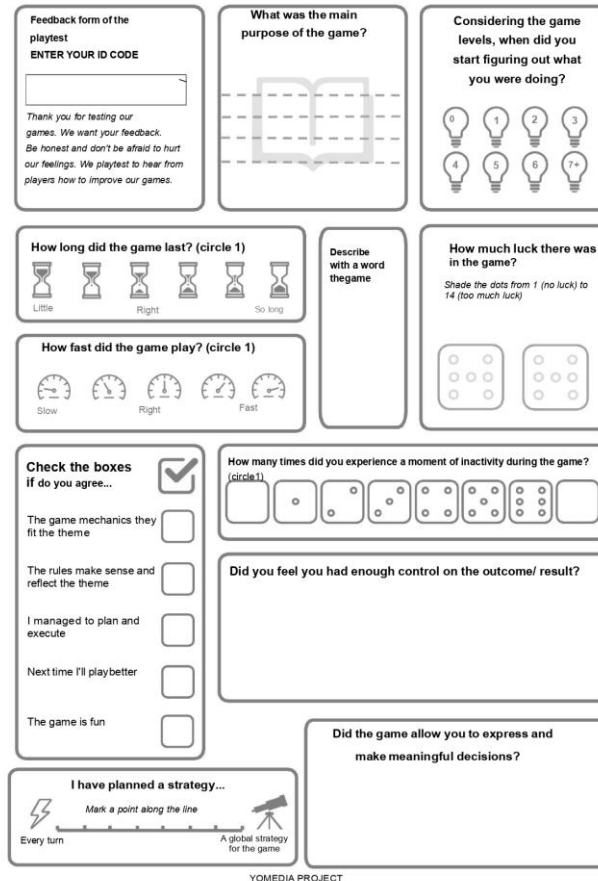
Phase 4. Post-game session: individual and collective reflection

The fourth phase is dedicated to re-elaborating the experience and is divided into two distinct moments.

Phase 4.1 – Individual reflexivity

At the end of gameplay, each student completes the graphic feedback sheet, which takes around 10 minutes. This tool enables participants to reflect immediately on the experience just lived. From a methodological perspective, this phase promotes an initial metacognitive activation, linking actions performed and subjective perceptions.

Figure 3. Graphic individual feedback sheet



The feedback sheet is divided into several sections:

- Feedback form of the playtest:** Includes a field for "ENTER YOUR ID CODE" and a thank-you message: "Thank you for testing our games. We want your feedback. Be honest and don't be afraid to hurt our feelings. We playtest to hear from players how to improve our games."
- What was the main purpose of the game?:** A large open book icon.
- Considering the game levels, when did you start figuring out what you were doing?:** Seven lightbulb icons numbered 0 to 7+.
- How long did the game last? (circle 1):** Six hourglass icons labeled "Little", "Right", and "So long".
- Describe with a word the game:** A large empty text box.
- How fast did the game play? (circle 1):** Five speedometer icons labeled "Slow", "Right", and "Fast".
- How much luck there was in the game?:** A 2x4 grid of dots with instructions: "Shade the dots from 1 (no luck) to 14 (too much luck)".
- Check the boxes if do you agree...:** A list of statements with checkboxes: "The game mechanics they fit the theme", "The rules make sense and reflect the theme", "I managed to plan and execute", "Next time I'll play better", "The game is fun".
- How many times did you experience a moment of inactivity during the game? (circle 1):** A row of seven boxes, each containing a different number of dots.
- Did you feel you had enough control on the outcome/ result?:** A large empty text box.
- Did the game allow you to express and make meaningful decisions?:** A large empty text box.
- I have planned a strategy...:** A horizontal line with a lightning bolt icon at the left end labeled "Every turn" and a satellite dish icon at the right end labeled "A global strategy for the game". The instruction is "Mark a point along the line".

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Phase 4.2 – Group reflection

A guided focus group follows, lasting 60–90 minutes, led by a moderator and supported by a note-taker/transcriber. The discussion is audio-recorded and follows a structured guide.

The focus group represents a central space for negotiating meanings, in which the gaming experience is reinterpreted in the light of media literacy and digital citizenship themes.

Table 1. Overview of the research procedure

Protocol phase	Main activities	Instruments used	Estimated duration	Role of researchers
Phase 1 Classroom session	– Introduction to the study; informed consent; administration of questionnaires	Student questionnaire; Teacher questionnaire	20–30 minutes	Introduction of the study, coordination, procedural clarifications
Phase 2 Participant selection	– Analysis of student questionnaires; selection of 5–6 students per class	Questionnaire database	Variable (off-class)	Data analysis; purposive sampling based on predefined criteria
Phase 3 Game session	– Individual gameplay with Data Defenders; in-situ observation	Data Defenders video game; Observation grid	~30 minutes per student	Non-interventionist observation (1:1 or 1:2 ratio); recording of behaviors and spontaneous verbalizations
Phase 4.1 Individual post-game reflection	– Immediate reflection on the gameplay experience	Graphical feedback form	~10 minutes	Administration of the tool; collection of completed forms

Phase 4.2 – Group post-game reflection	Guided discussion and collective reflection	Focus group and guide; audio recording	60–90 minutes	Moderation of the discussion; transcription; ensuring a non-evaluative climate
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5. Data analysis strategy

The data analysis strategy is designed to systematically integrate the quantitative and qualitative data collected through the different instruments, in order to answer in a comprehensive way the research questions on the role of the game Data Defenders in activating processes of Media and Information Literacy (MIL), empowerment and critical thinking.

The chosen approach follows the principles of mixed methods research, in which data integration is considered a fundamental epistemological step and not just a final aggregation of results.

5.1 Preparation and organisation of data

Before proceeding to analysis, all collected data are organised and prepared in formats compatible with the respective analytical techniques:

- Quantitative data: the datasets from the student and teacher questionnaires are coded, cleaned (checking for missing data and input errors) and entered into statistical software (SPSS) for descriptive and inferential analyses.
- Qualitative data: the focus group transcripts, the playtest observation grids and the open-ended responses in the questionnaires are fully transcribed into text format and imported into qualitative analysis software (NVivo) for structured coding.
- Graphic feedback sheets: visual data are converted into numerical categories or thematically coded to facilitate integration with the other datasets (e.g. perception scores, experience categories).

This preliminary phase is crucial to ensure data quality and consistency and to allow subsequent comparisons across the various levels of analysis.

5.2 Quantitative data analysis

For the student and teacher questionnaires, a multi-step quantitative analysis is planned:

a) Descriptive analysis: frequencies, percentages, means and standard deviations are calculated to describe the sample (e.g. gaming profile, competence perceptions,

attitudes towards video games). This phase makes it possible to outline typical profiles and understand the distribution of the main variables of interest.

b) Scale construction: using internal consistency techniques (for example, Cronbach's alpha coefficient), the coherence of the psychometric scales used (empowerment, problem solving, self-perceived MIL) is assessed. Consolidated scales are then used as composite variables for subsequent analyses.

c) Preliminary inferential analysis: if the sample size permits, exploratory comparisons (e.g. t-tests, ANOVAs) are carried out between emerging groups (e.g. gaming experience profiles) to identify significant differences in self-reported perceptions or competences. These results help to interpret patterns observed in the qualitative phases of the game.

These quantitative procedures provide contextual and baseline indicators that enrich qualitative interpretation and make it possible to grasp relevant associations between background variables and in-game behaviours.

5.3 Qualitative data analysis

Qualitative analysis focuses on data from observation grids, focus groups and open-ended responses in questionnaires and graphic sheets.

The strategy adopted combines deductive and inductive thematic coding, in line with well-established approaches in qualitative literature.

a) Initial coding and thematisation: textual data undergo an initial open coding, where text segments are labelled with descriptive codes tied to theoretical constructs (e.g. strategy, information evaluation, adaptation to error, perception of control). This step makes it possible to identify behavioural patterns and emerging reasoning processes.

b) Axial and relational coding; axial coding follows, in which initial codes are organised into broader categories and relationships between concepts are explored (for example, how the use of the Data Analyzer connects to planning strategies and reflections on informational content). The aim is to construct a map of the processes activated by the game in terms of MIL and critical thinking.

c) Validation and internal triangulation: to increase interpretive reliability, multiple independent researchers analyse the same dataset, compare coding, and resolve discrepancies through methodological discussion.

This intra-researcher triangulation is a recognised practice for enhancing qualitative credibility.

5.4 Data integration (mixed methods integration)

The most strategic phase of the analysis is the integration of quantitative and qualitative data, following mixed methods principles that require alignment and integration of results to achieve a deeper understanding of the phenomenon under study.

a) Methodological triangulation: quantitative results (scales, group comparisons) are put in dialogue with qualitative results (categories emerging from coding) to check for convergences and divergences. For example, perceived empowerment profiles can be compared with observed behaviours of planning and resource management in the game.

b) Joint display analysis: comparison tables (joint displays) are constructed that place numerical data alongside qualitative excerpts to highlight how certain response patterns (e.g. high perception of critical capacity) relate to actual behaviours (e.g. strategic use of the Data Analyzer). This step is important to show how qualitative data enrich and explain quantitative trends.

c) Interpretive synthesis: the final aim is not simply to aggregate results, but to draw integrated inferences that answer the research questions coherently with the theoretical constructs (MIL, empowerment, critical thinking). In this phase, sets of convergent or divergent evidence are highlighted and interpretations are formulated based on both numerical indicators and qualitative meanings.

6. Results

This section presents the preliminary results emerging from the integrated analysis of quantitative and qualitative data, relating them to the theoretical framework and to the pedagogical hypothesis underlying the game design of Data Defenders. The results are organised along interpretive axes consistent with the constructs under investigation - Media and Information Literacy (MIL), empowerment and critical thinking - and with the key mechanics of the video game.

6.1 Gaming profiles and initial perceptions (quantitative data)

The descriptive analysis of the student questionnaires shows heterogeneity in gaming profiles, with expert players, occasional players and students with limited or no video game experience. This variability, intentionally sought during participant selection, made it possible to observe different ways of approaching the game and its cognitive demands.

With regard to self-perceived competences, overall positive mean values emerge on the scales related to:

- problem solving and strategic thinking, particularly in relation to the ability to experiment with alternative solutions and plan actions
- empowerment, with frequent references to a sense of control and to managing challenges
- collaboration and communication, especially with reference to prior gaming experiences in social or online contexts.

The questions concerning information literacy practices show greater variability: while many students report using criteria for selecting sources and recognising the need to verify information, there are still responses indicating intuitive or poorly structured strategies. This finding confirms the relevance of observing MIL not only as a self-reported competence, but as a practice enacted in situ.

6.2 Game strategies and decision making in action (qualitative observation)

Analysis of the observation grids highlights recurring behavioural patterns during the game session with Data Defenders. In particular, three macro-types of strategies emerge:

- Exploratory strategies, characterised by repeated attempts, experimentation with different configurations and frequent adjustments in response to system feedback.
- Planned strategies, in which the player anticipates waves, distributes resources consistently and displays a more global strategic vision.
- Reactive strategies, more tied to the urgency of the moment, with rapid but less systematic decisions.

Regardless of the initial gaming profile, many students show a progressive evolution in their strategies, moving from exploratory modes to more structured forms of planning. This element is particularly relevant in relation to reflective decision making, understood as the capacity to learn from error and adapt one's choices on the basis of experience.

6.3 The role of the Data Analyzer: information literacy in context

One of the most significant findings concerns the use of the Data Analyzer, observed as a key mechanic for activating Media and Information Literacy processes. Observations show that:

- Activation of the Data Analyzer tends to concentrate in moments perceived as “critical” in the game
- Some players use it systematically, integrating it into their overall strategy
- Others use it sporadically or belatedly, often after having experienced negative consequences.

During gameplay there are also spontaneous verbalizations related to “checking information” or “understanding whether something is reliable”, indicating an initial level of metacognitive awareness. These behaviours suggest that information evaluation is not experienced as an external or imposed task, but as an action functional to success in the game. From a theoretical standpoint, this result supports the idea that game mechanics can act as situated MIL devices, in which competence is manifested through operational choices and not only through correct answers on tests or questionnaires.

6.4 Perception of the experience and individual reflection (graphic sheet)

The graphic feedback sheets provide useful indications for understanding how students subjectively interpret the gaming experience. In particular:

- Most participants report having understood the game's objectives within the first level;
- There is a generally positive perception of the sense of control and of the possibility of making meaningful decisions;
- Many students recognise the importance of planning, positioning themselves towards a global strategy rather than exclusively turn-by-turn play.

These data are consistent with the observations made during gameplay and suggest a convergence between observed behaviours and subjective perceptions, re-

inforcing the hypothesis of a gaming experience capable of supporting agency and empowerment.

6.5 Collective reflection and transferability of competences (focus group)

The post-game focus group represents the moment when processes implicitly activated by the game are made explicit and collectively negotiated. Thematic analysis reveals four main nuclei:

- Awareness of informational dynamics, with references to the speed of circulation of information and to the difficulty of distinguishing reliable content.
- Recognition of the value of verification, often explicitly linked to the use of the Data Analyzer.
- Strategies of adaptation and learning from error, described as an integral part of the experience;
- Perception of transferability, in which students state that some competences exercised in the game - such as checking sources or managing uncertainty- are “useful outside the game as well”.

These findings indicate that the video game can function as a mediated reflective space, capable of activating connections between the gaming experience and digital citizenship practices.

From a pedagogical perspective, these results strengthen the hypothesis that a coherently designed video game can support forms of situated and reflective learning, turning information evaluation into a necessary and meaningful practice rather than an abstract content.

7. Discussion

The present study set out to explore the potential of a digital game-based experience, Data Defenders, not only as an educational tool but as a research device capable of activating and rendering observable processes related to Media and Information Literacy, empowerment, and critical decision making. Interpreted through an integrated mixed-methods lens, the results support four key discussion points that contribute to both educational theory and methodological innovation.

The findings suggest that Data Defenders functions as a reflective device rather than merely as a motivational or instructional artifact. Reflection is embedded within gameplay through moments of interruption, uncertainty, and consequence-driven choice (Kinsella & Coemans, 2024). Mechanics such as the Data Analyzer introduce intentional pauses that require players to interpret information and evaluate possible courses of action before proceeding. This design aligns with perspectives that conceptualize learning as a cyclical process of action and reflection, in which meaning is constructed through experience and re-elaboration rather than transmission (Soares et al., 2023). The game environment supports reflection-in-action, as players adjust strategies and revise decisions in response to system feedback (Rodgers, 2022), while post-game phases extend this process into reflection-on-action, allowing implicit reasoning to become explicit. From this perspective, the video game operates as a mediating artifact that structures reflective activity (Pivec & Kearney, 2024), rein-

forcing the idea that reflection in game-based learning results from deliberate design choices and methodological scaffolding rather than from play alone (Oelofsen, 2020).

Empowerment emerges not as a stable trait or purely self-perceived disposition, but as a situated and processual construct activated through interaction with the game system. Observational data indicate that empowerment manifests through behaviors such as experimentation, persistence after failure, strategic adaptation, and increasing control over decisions and outcomes. Importantly, empowerment is not uniformly distributed based on prior gaming experience: even participants with limited gaming backgrounds demonstrate growing agency over time, particularly when supported by clear feedback and opportunities for low-risk experimentation. This suggests that empowerment in game-based contexts is co-constructed through the interaction between player, rules, and feedback rather than being solely dependent on pre-existing competencies.

The convergence between observed behaviors and self-reported perceptions of control and confidence further supports an interpretation of empowerment as a dynamic process emerging through action and reflection. This has relevant implications for educational design (Rikard & Banville, 2020), indicating that fostering empowerment requires environments that enable meaningful choice, responsibility, and consequence rather than relying primarily on motivational appeal. Moreover, the study reveals a qualitative shift in empowerment over the course of the session. Participants initially display forms of “functional empowerment,” focused on mastering game mechanics to progress. As the information crisis intensifies, this shifts toward “critical empowerment” (Tong & An, 2022), in which agency derives from the ability to recognize and interpret systemic biases rather than from speed or efficiency alone.

A further contribution of the study lies in its treatment of Media and Information Literacy as an enacted competence rather than a purely declarative or self-reported one. While questionnaire data capture students’ perceptions and stated practices, gameplay observations reveal how MIL is performed in context. Students do not engage in information evaluation uniformly; instead, verification practices emerge in response to perceived risk, uncertainty, or negative consequences. This finding reinforces the view that MIL develops through situated engagement with information, where evaluation becomes meaningful because it produces tangible effects (Hobbs & Tucci, 2020). The alignment between observed behaviors, graphical feedback, and focus group reflections indicates that the game provides a coherent environment in which information literacy is practiced, recognized, and articulated. As such, the study supports a shift from conceptualizing MIL as a checklist of skills toward understanding it as a context-dependent practice shaped by systems, constraints, and goals (Breakstone et al., 2021).

Finally, the study highlights the educational and methodological value of playtesting when adapted from game design to educational research (Sweetser & Wyeth, 2021). The observational grid inspired by playtesting protocols enables the systematic capture of decision-making processes and player–system interactions that often remain invisible to traditional assessment tools (Kafai & Burke, 2024). Embedded within a mixed-methods framework, playtesting allows researchers to observe learning as it unfolds, bridging performance and reflection (Pavlou, 2020). When combined with post-game debriefing, it supports forms of assessment aligned with contemporary approaches to formative and game-informed evaluation (Sweetser & Wyeth, 2021). This methodological contribution is particularly relevant for studying

complex competencies such as Media and Information Literacy and critical thinking, which are difficult to isolate through standardized instruments alone (Ifenthaler, 2021).

8. Conclusions

Taken together, the findings of this study support the interpretation of Data Defenders as a hybrid space that functions simultaneously as an educational environment and a research laboratory. Within this space, reflection, empowerment, and Media and Information Literacy are activated through cycles of action, feedback, and guided re-elaboration.

The study shows that reflection in game-based learning is not an automatic outcome of play, but the result of deliberate design choices that embed moments of interruption, uncertainty, and consequence into gameplay. By structuring reflective processes within player–system interactions, the game supports both reflection-in-action and reflection-on-action, positioning the video game as a mediating artifact rather than a neutral delivery mechanism (Pelizzari & Marangi, 2025).

Empowerment emerges as a situated and dynamic process, co-constructed through interaction with rules, feedback, and decision-making opportunities. The progression from functional to critical empowerment suggests that effective Media and Information Literacy games should allow learners to experience failure and disempowerment as integral to the development of critical agency.

A further contribution of the study lies in its conceptualization of Media and Information Literacy as an enacted, context-dependent competence. Rather than treating MIL as a static set of skills or self-reported dispositions, the findings highlight how critical information practices emerge through situated engagement with information and feedback.

Finally, the study demonstrates the methodological value of integrating playtesting into educational research. Embedded within a mixed-methods framework, playtesting enables the observation of learning processes in dynamic, system-based environments and offers promising directions for researching and assessing complex competencies that resist standardized measurement.

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