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Designing playful education: a game changing matrix to rule ‘em all

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Designing playful education: a game changing matrix to rule 'em all

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Abstract: Games have transcended their role as mere entertainment tools evolving into powerful mediums for driving meaningful change. Whether addressing environmental sustainability, health promotion, or educational engagement, these games for change hold immense transformative potential. However, the successful design of this type of games requires consideration of several aspects (context, objectives, participants, game elements), and there are no structured methods available yet to support this process. To fill this gap, this paper introduces the Game Changing Matrix, a novel methodology developed to support the design of games aimed at meaningful transformation. Building on the frameworks of the MDA (Mechanics, Dynamics, and Aesthetics) and taking inspiration from the journey map method, the proposed methodology offers a structured, modular, practical tool for both experienced and novice designers. By fostering interdisciplinary collaboration, the Game Changing Matrix helps aligning game elements with desired educational (or behavioural changes) outcomes, making it a valuable resource for tackling contemporary challenges in design education.

Keywords: *design methodology; game design; design education; game for change*

Introduction

Nowadays games are no longer confined to entertainment, rather they have become powerful tools for addressing complex social, environmental, and educational challenges.

From Piaget's (1945) insights into cognitive development to Vygotsky's (1929) emphasis on the social and cultural dimensions of play , and Winnicott's (1971) reflections on the space of play, it is evident that play supports learning and personal growth at all stages of life. Play precedes culture and helps shape it: it creates social bonds and symbolic spaces in which rules, hierarchies, and conventions are co-constructed. Huizinga (1946) even sees civilization as a grand performance or a system of collective games, while for Cross (2020) role-playing games represent creative workshops that allow players to experiment with genders, identities, and possible futures. For Caillois (1958) and Goffman (1974), play is conceived as a tool for understanding and making sense of the external world, whereas game designers such as Clark and Alder use games as a means to create intimate experiences that support self-discovery and exploration. This transformative capacity of games has been explored both theoretically and empirically. For

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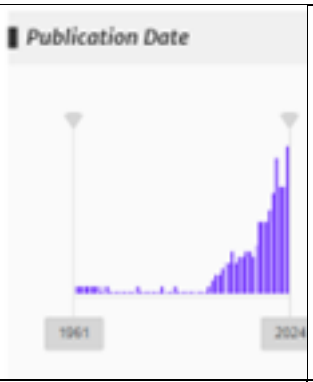
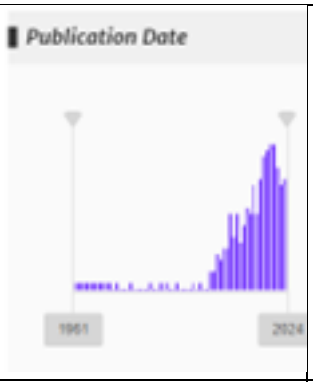
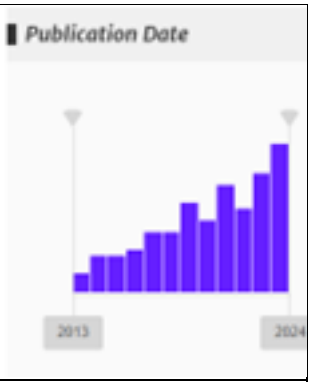
instance, Flanagan (2009) highlights how games can serve as critical cultural artifacts capable of questioning norms and provoking reflection. Bogost (2007) introduces the concept of procedural rhetoric to explain how games can convey complex arguments through their rule-based systems. Similarly, Barab et al. (2010) propose the notion of transformational play, emphasizing how games can reposition players within meaningful contexts, prompting shifts in identity, values, and understanding. This approach is reflected in therapeutic contexts as well: projects such as *Re-Mission* (Kato et al., 2008), *Packy and Marlon* (Brown et al., 1997), and *SuperPowerMe* (Marti et al., 2024) were designed to provide a playful, empowering experience that supports increased adherence to medical treatments.

Whether in the form of role-playing games, board games or video games, play allows individuals to develop a wide range of skills. These include cognitive skills (Blackmon, 1994; Ginsburg, 2007; Bavelier, 2012), social skills (Parten, 1932), and emotional skills (Pellegrini, 2009; McGonigal, 2011; Fitzpatrick et al., 2013; Russoniello, 2013). Play can also foster empathy (Soares, 2015) and strengthen social relationships (Zhang, 2016).

In recent years, educational institutions have shown increased interest in applying games, playful activities, and gamification, especially in formal learning settings. A search in the ACM Digital Library database reveals a significant increase in publications on this subject over the past two decades, highlighting the growing scientific interest in this field (Table 1).

Table 1. Graphs provided by the ACM Digital Library show the growing number of scientific publications mentioning play, game, education and didactics, over the years (research done in November 2024).

			
3,762 Results for: [[Abstract: gam*] OR [Abstract: play]] AND [[Abstract: education*] OR [Abstract: didactics]]	2,166 Results for: [Abstract: play] AND [[Abstract: education*] OR [Abstract: didactics]	1,500 Results for: [[Abstract: gam*] OR [Abstract: play]] AND [Abstract: school]	317 Results for: [Abstract: gamification] AND [[Abstract: education*] OR [Abstract: didactics]]

This growing field has attracted diverse disciplinary perspectives to investigate the impact of games and gamification in educational settings, as well as to design powerful playful activities. Research into multidisciplinary approaches in educational game design shows that combining knowledge from psychology, pedagogy, and game design can significantly enhance learning outcomes. Bellotti et al. (2013) argue that this integration ensures that games are both engaging and pedagogically sound. Greitzer et al. (2007) show how cognitive science improves training effectiveness in serious games, while adaptive mechanics support personalization (Lopes & Bidarra, 2011). Such frameworks are pivotal in bridging academic theory with practice, ensuring the design of games that address cognitive, social, and emotional aspects of learning. Additionally, the integration of diverse strategies enables the development of innovative mechanics and narratives. The interdisciplinary approach bridges the gap between learning objectives and player engagement, fostering skill development across cognitive, social, and emotional domains.

Despite the increasing number of studies focusing on the educational and psychological impact of games, the field remains largely dominated by research on digital serious games, particularly those designed for training or simulation. In parallel, a growing body of literature explores the use of gamification — the application of game-like elements in non-game contexts — to foster motivation and engagement. However, in both areas, research is often fragmented, with limited attention to the systemic design processes needed to align gameplay with meaningful transformation. As highlighted by Almeida and da Silva (2013), there is a notable lack of structured methodologies addressing the design of non-digital experiences. This limitation becomes even more apparent when games are developed outside the traditional entertainment industry or research facilities —by educators, activists, or interdisciplinary teams—without formal training in game development. In these cases, practitioners often face the dual challenge of designing both

meaningful play experiences and impactful learning outcomes, without adequate design frameworks to support this process.

To address this methodological gap, this paper introduces the Game Changing Matrix (GCM) — a tool designed to support the creation of games with transformative potential. Understanding the rationale behind the GCM requires clarifying the conceptual evolution from *Serious Games* to the broader category of *Games for Change*.

Games for Change

Clark Abt (1970) defined serious games as those designed with objectives that go beyond mere entertainment. He described these games as having explicit, carefully considered educational goals, setting them apart from commercial games primarily aimed at enjoyment. Building on this, Michael and Chen (2006) emphasized the role of serious games as interactive applications aimed at educating, training, or raising awareness around specific topics. Djaouti et al. (2011) further highlighted the capacity to promote behavioral change and to convey specific knowledge. Zyda (2005) offered another perspective, defining serious games as mental contexts played under specific rules, utilizing entertainment to achieve strategic goals in training, education, public health, and communication.

While these definitions primarily focus on digital games, analogue experiences — such as board games, role-playing games, and live-action role-play — can also be designed with formative and educational purposes that go beyond mere entertainment. These types of games broaden the scope of serious games and can be better described as *purpose-driven playful environments*, intentionally crafted to influence players beyond the boundaries of entertainment by conveying values, ideas, and even persuasive messages.

When the playful component of a game serves not as its ultimate goal but as a motivational lever to facilitate learning — understood here as behavioural change through experience — the game aligns with the broader concept of "Games for Change". This concept encompasses a wide range of purpose-driven games, and it is used as the main reference in this paper to define games that can be leveraged for transformative educational and social outcomes. While gamification refers to the use of game-like elements in non-game contexts to influence behavior (Deterding et al., 2011), Games for Change are designed as complete, meaningful experiences that aim to generate long-term transformations. These environments go beyond persuasion, aiming instead to co-create value through engagement and empathy. In this sense, Games for Change align with what Barab et al. (2010) define as transformational play, where the player is not just a passive user but an active agent of change within a consequential narrative. These approaches build on the foundations laid by authors such as Flanagan (2009), who frames game design as a critical practice, and Bogost (2007) who demonstrates how persuasive power can be embedded in the very mechanics of games.

Games for Change hold great potential to engage and educate meaningfully. However, creating such games demands more than a creative vision. Indeed, it requires structured methodologies that align purpose, engagement, and impact.

Despite the growing interest in this topic, existing methodologies often fall short of addressing the complexity involved. Indeed, our experience revealed a lack of comprehensive and structured tools specifically tailored to the design of games for change. Parker and Becker (2014) aptly summarize this limitation:

"There is a dearth of design models for educational game design. Instead, what is most commonly found are guidelines or design issues, which amount to things that should be kept in mind while designing such a game. These can be useful, but assume that one already knows how to design a game, and that an educational game is a game with extra conditions and content" (Parker & Becker, 2014, p.185).

To fill this gap, we created the Game Changing Matrix (GCM): a methodology designed as a structured tool for designers, educators, and researchers who aim to create impactful games for change. The methodology seeks to bridge theory and practice, providing practical guidance for aligning game design with transformative educational and social goals.

The Game Changing Matrix

In the research context of the Santa Chiara Fab Lab of the University of Siena, we developed the Game Changing Matrix (GCM) methodology by building upon two well-established tools in the design field. The first is the MDA Framework (standing for Mechanics, Dynamics, and Aesthetics), conceptualized by Hunicke et al. (2004), which

provides a set of concepts related to the game features. The second is the Journey Map method, which helps structure and visualise the information. In the following paragraphs, we outline the theoretical foundations of the GCM and explain how it can be used to design games for change. A case study is then presented to illustrate a practical application of the methodology.

A critical positioning of the CGCM within the game design landscape

To develop the GCM methodology, we analysed a wide range of existing game design frameworks, spanning from scientifically validated models to practitioner-developed guidelines (Figure 1).

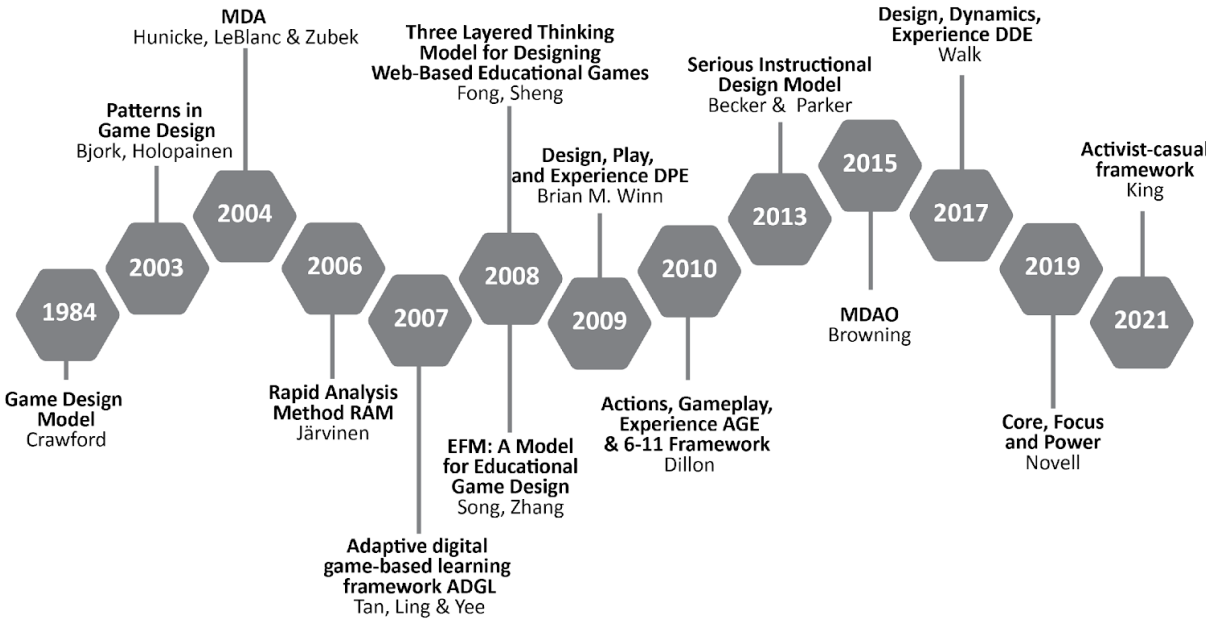


Figure 1. Visual timeline of the game design frameworks analysed to develop the Game Changing Matrix.

Each framework contributes in its own way in facilitating the game design process. While the Game Changing Matrix (GCM) draws conceptually from the MDA framework and adopts the structure of the journey map, it introduces several critical improvements compared to existing game design frameworks—particularly when applied to educational, transformative, and purpose-driven play.

Most traditional frameworks — like MDA (Hunicke et al., 2004), DDE (Walk et al., 2017), or the more recent adaptations combining game design with design thinking — tend to focus either on the formal structure of games (mechanics, systems, interactions) or on the emotional experience of play. However, they often lack operational tools that support the complex, iterative design of games with non-entertainment objectives.

As observed by Almeida and da Silva (2013), many of the existing approaches suffer from conceptual fragmentation, lack of shared vocabulary, or excessive focus on digital contexts. In particular, frameworks like MDA are extremely useful for conceptual analysis and educational purposes, but provide little support for actual design practice, especially when trying to align gameplay with behavioral or attitudinal change.

The GCM fills this gap by translating abstract frameworks into a structured, modular tool that can be used by both expert designers and non-designers. Unlike descriptive or linear models, it offers:

- a bottom-up logic starting from the desired change and leading up to concrete game elements;
- an explicit focus on emotions and transformation, not only as outcomes but as prerequisites to trigger change;
- a matrix structure that accommodates complexity, recursion, constraints, and phase-specific decisions;
- a co-design potential, supporting interdisciplinary collaboration through a shared visual and semantic language.

Furthermore, the GCM is not intended as a one-size-fits-all solution but as a critical tool for reflection and iteration: it can be used to design new games, analyze existing ones, and even evaluate post-hoc their alignment with intended

change. In this way, the GCM responds directly to critiques like those of Parker and Becker (2014), who note the lack of structured, actionable methodologies for serious game design, and aligns with emerging needs for flexible, context-sensitive, and empirically grounded design tools in the field of Games for Change.

From a Framework to a Holistic Approach to Game Design

The Game Changing Matrix contributes to a broader shift from isolated, descriptive frameworks toward a holistic approach to game design, where all components of a game are treated as interdependent. Rather than analyzing games solely through structural or experiential lenses, the GCM offers an integrated method that aligns mechanics, dynamics, aesthetics, narrative, accessibility, sustainability, ethics, and — crucially — desired outcomes into a unified design ecosystem.

This systemic approach enables both the design and evaluation of games not only at the level of playability or engagement, but also in relation to target-specific needs, contextual constraints, and transformation goals. It helps transition from a classical "game design logic" to a purpose-driven, user-centered and change-oriented process.

Building on systems thinking in game design, Salen & Zimmerman (2004) emphasize that games should not be approached as linear sequences of mechanics, but rather as dynamic, interdependent systems composed of rules, interactions, player feedback loops, and cultural context. This perspective anticipates a multidimensional understanding of the game experiences, where design decisions operate on different but interrelated levels— mechanical, aesthetic, narrative, and social. In this light, the Game Changing Matrix aligns with and expands upon Zimmerman's vision, offering a structured framework that captures both the internal logic of the game and its external implications for learning and change. By explicitly mapping the relationship between in-game actions and real-world transformation, the GCM makes the systemic nature of design both visible and actionable.

The GCM reflects this vision by positioning the game in three complementary roles.

- Game as a system – In its most technical sense, the game is understood as a structured system composed of rules, resources, interfaces, and player actions. This allows for granular control of physical/digital components, including accessibility, tactile experience, and sustainability.
- Game as part of a system – The game is embedded in a broader experiential and social context. It catalyzes interactions, emotional states, and interpersonal dynamics that extend beyond scripted mechanics. Here, the "magic circle" becomes a participatory space of reflection and negotiation.
- Game as an agent of system change – The game functions as a transformational medium. Within a Vygotskian view of the zone of proximal development, games act as expert systems, fostering informal learning and behavioral shifts. Their structured-yet-flexible nature makes them particularly suitable for facilitating value transmission, identity exploration, and collective empowerment.

As Bellotti et al. (2013) highlight in their overview of serious games, the effectiveness of educational or transformational games relies on the delicate alignment of engaging gameplay, meaningful content, and contextual relevance. Their work underlines the importance of integrating multiple disciplinary insights — particularly from pedagogy, psychology, and Human-Computer Interaction — to ensure that games are not only enjoyable but also impactful. The Game Changing Matrix responds to this challenge by operationalizing the alignment between emotional engagement, behavioral objectives, and game structure. Its layered format allows designers to consider how each design decision supports or undermines the desired change, taking into account real-world constraints such as audience, resources, and context of use.

This layered, systemic view enhances the designer's capacity to reflect critically not only on tangible aspects of the game, but also on the intangible forces that shape the experience and its potential impact. It supports iterative design decisions based on real-world constraints and ambitions for change, making the GCM a practical and reflective tool for contemporary educational and social game design.

Theoretical Foundations

Among the different frameworks (Fig. 1), we selected the MDA framework because of its formal and widely adopted approach in game development to analyze game systems, fostering a connection between design and player experience. Introduced by Robin Hunicke, Marc LeBlanc, and Robert Zubek (2004), the MDA framework divides the design process into three core components:

- Mechanics refer to the fundamental building blocks of the game -rules, algorithms, and data that define its functionality;
- Dynamics describe the system design and interactions that emerge during gameplay from the mechanics and players inputs;.
- Aesthetic concern the emotions and experiences elicited in the player, such as enjoyment, challenge, or surprise.

The MDA framework is notable for its iterative approach, enabling developers to simultaneously consider the perspective of both the creator and the player. This framework aligns design goals with the desired player experience, ensuring a balance between technical structure and emotional impact. The perspective offered by MDA has profoundly influenced the field of game design study, establishing itself as a widely adopted educational and practical tool.

However, while the MDA is conceptually strong, it still fails to concretely support game designers in developing game-based interventions. In light of this, we combined the MDA framework with the method of the Journey Maps, commonly used in user experience design (Kalbach, 2020). They provide a chronological narrative of a user's interactions with a product, service, or system over time. These maps typically highlight thoughts, emotions, and pain points across key touchpoints of the journey. By combining qualitative and quantitative data, Journey Maps offer a holistic and intuitive view of the user journey. They help stakeholders identify areas for improvement, align interventions with user needs, and strategically plan more empathetic and effective solutions.

Drawing from this approach, we structured the Game Changing Matrix as a Journey Map. It uses a grid format (rows and columns to be filled out) which guides designers in defining all aspects of the game experience. Each element of the matrix is informed by the MDA framework, ensuring a balance between game structure and player experience.

How the Game Changing Matrix works

Before filling out the Game Changing Matrix, two preparatory steps are essential to lay the groundwork for the game design process.

1. Define the goal for change: What transformation is the game meant to promote — in terms of values, attitudes, behaviors, or knowledge?
2. Analyze the context: Assess where the game will take place. Consider constraints (e.g., available budget, instructional time) and opportunities (e.g., students' familiarity with related games or themes).

These decisions are pivotal to inform the game design process. For example:

> a teacher might begin by defining the learning or behavioral change objectives (e.g., consolidating knowledge on biodiversity while emphasizing the importance of adopting sustainable practices for the use of natural resources). The analysis of the context would then identify critical challenges, needs, and opportunities (e.g., challenges: lack of one computer per student; needs: activities suitable for students with special educational needs; opportunities: widespread familiarity with Pokémon trading cards).

Once the preliminary steps are completed, the GCM functions like a Journey Map, structured as a grid:

- The rows represent key design dimensions — Mechanics, Dynamics, Aesthetics, Changes;
- The columns represent phases of the game experience.

The matrix is compiled by creating columns (one column for each phase of the game experience) and defining the game elements for each column (Figure 2). Then, each phase of the experience is detailed using expanded categories derived from the MDA framework: mechanics, dynamics, aesthetics, and the additional layer of the changes to promote through the game experience.

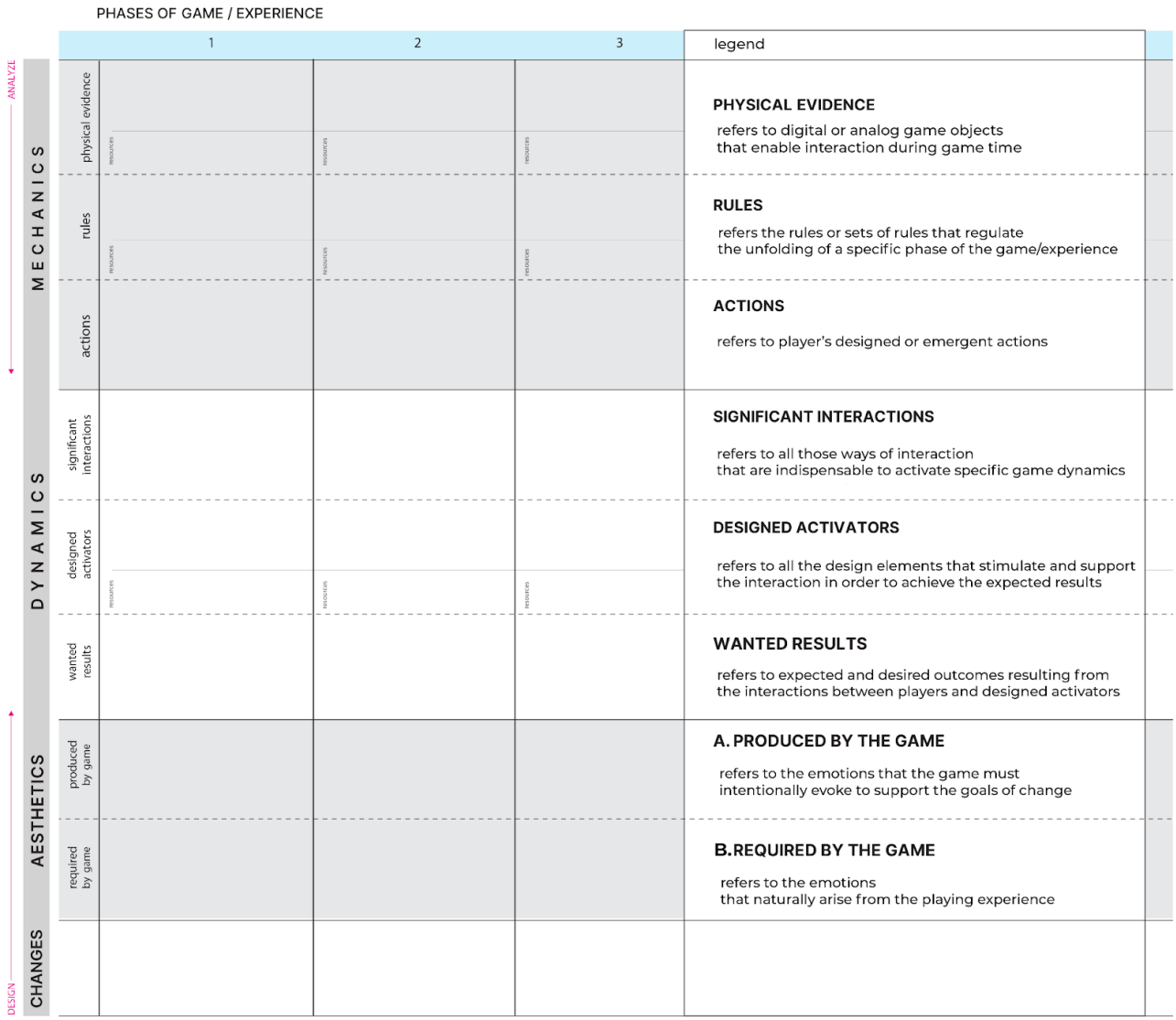


Figure 2. Structure of the Game Changing Matrix with predefined rows and columns to compile.

At the top of the matrix, a timeline can be added to represent game duration or intervention period (e.g., class sessions, therapy phases). This section can highlight context-imposed constraints and can be managed across multiple lines to accommodate complexity.

The matrix is compiled from the bottom to the top, from the "Changes" section to the "Mechanics" section, and in this way the decisions taken in one section orient the decisions to be made in the subsequent section. It is possible, and sometimes useful in the conception phase, to jump from one section to another and use the matrix to fix some ideas and give them shape by filling in the connected sections.

To facilitate the idea generation, the sections of the Game Changing Matrix are enriched to provide one or more critical questions that the game designers can ask themselves to define the characteristics of the game experience, always keeping in mind the desired change and the characteristics of the context. Let's keep going with the example of the teacher.

> The teacher decides to develop a card game requiring minimal resources, which can be printed in school (*physical evidence/resources*). They design a collaborative yet competitive game (*rules*) to maintain student engagement (*wanted results*). The game is structured around two teams (*rules/significant interaction*): one tasked with preserving the biodiversity of a region, and the other with exploiting its resources. The goal is to achieve equilibrium, ensuring both population and environmental prosperity (*rules*). Gameplay involves strategic decisions by each team, utilizing a deck of cards to affect their field or that of their opponent (*physical evidence/rules*).

The design process starts at the bottom part of the matrix by identifying the desired changes as the game should promote and considering which emotional states might best position the player in embracing those changes. The next step involves designing the interactions that can evoke these emotional states or communicate specific content. Moving upward in the matrix, these interactions are then paired with their respective rules and mechanics to create a cohesive design.

The row labeled "*Changes*" (triggered) serves to define the transformation expected from the game experience. These changes can be related to the entire game experience or they can target a specific phase, ranging from acquiring knowledge (e.g., learning the capitals of European countries) to fostering empathy (e.g., understanding the stories of migrants) or performing prescribed actions (e.g., completing rehabilitation exercises).

> The teacher decides that the main objective of the change will be to consolidate knowledge on biodiversity. In this sense, raising awareness about the importance of adopting sustainable practices for managing natural resources becomes a dynamic objective to be integrated into the gameplay.

The section of Aesthetics, broadly interpreted, is divided into two categories.

- *Aesthetics produced by the game* refers to the emotions that naturally arise during the experience as a result of specific game elements — for example, the sense of challenge generated by a game like Risk.
- *Aesthetics required by the game* refers to the emotions that need to be triggered in order to activate the intended change — for instance, a sense of frustration used deliberately at a certain point in the game to promote empathy with a character.

Continuing the example:

> As the preliminary concept is placed into the *matrix*, the teacher asks themselves critical design questions: *How do I want my students to feel? What aesthetics will engage them while focusing on the content?*
> Reflecting on these, the teacher recalls two environmentally active students expressing concerns about eco-anxiety. To mitigate this, the game setting is relocated to a distant, fictional planet (designed activators), reducing mirroring (aesthetics produced by the game) with present-day realities (wanted results).

The section of *Dynamics* includes three subcategories.

- *Significant interactions* refer to types of engagement that add meaningful value to the experience and align closely with either macro or micro learning objectives, such as the act of "squeezing" in the game Taboo.
- *Designed activators* are elements of interactions intentionally designed to achieve specific results (e.g., the shape of the game board, the character design).
- *Wanted results* refer to the intended outcomes coming from the interactions with the designed activators, such as a good grip on a token, active engagement, mirroring with a character.

Returning to the example:

> The teacher also sets micro-change objectives, when they decide that it might be interesting to make the students understand the importance of the research when talking about environmental issues and the use of natural resources. *How can this micro objective be achieved? Are the game elements you've thought of up to now enough?*
> This further objective of change could be implemented in a specific phase of the game (*rules*), which is why he decides to create a new deck of cards (*physical evidence*): "the research".

The section of *Mechanics* includes three subcategories.

- *Physical evidence* refers to the game objects, which can be either digital (maps, inventories, individual items) or analogue (tokens, cards, tiles).
- *Rules* refer to the rules or rule sets that apply to the phase.
- *Actions describe* player actions: these can be designed actions (mandatory, suggested, or subordinate actions explicitly outlined by the rules) or emergent actions (unplanned behaviours arising during gameplay, including errors).

Continuing with the example:

> The teacher imagines the new deck of cards helping players explore the biodiversity and resources of the fictional planet, seamlessly embedding scientific content into gameplay (*significant interactions*). This shared deck is accessible to both teams and

offers additional information—such as data on raw materials or technologies—which players can use to gain in-game advantages. The *wanted result* of this new dynamic should be not only to provide new information but also to make people perceive the importance of scientific research. The *aesthetic* produced and requested by the game in this phase should be focused on generating attention and interest, which are crucial for making thoughtful, strategic decisions. A secondary emotional layer, such as competition, may also emerge —especially since the "researcher" cards are shared between teams.

Within the sections for physical evidence and rules, it is also possible to include information about the "*resources*," defined as design constraints or requirements such as material costs, development time for a specific mechanic, or the contents required for the implementation. These considerations help determine feasible design solutions based on the available resources.

The teacher thinks about the creation of a prototype that will require developing both content and game tools (physical evidence). Questions arise: How should I build content? Do I have all the information I need? To create an accessible game for all people in the class, what characteristics should the game materials have?
The teacher may focus on developing educational content while involving eco-activists to contribute with sustainability-related practices. Recognizing accessibility needs from the contextual analysis, the game minimizes text, adopts iconography, and ensures font sizes and styles are accessible (designed activators/physical evidence). To develop the icons, the teacher engages students, encouraging them to design symbols for various plant, animal, and mineral categories on the alien planet.

During the design phase, the matrix can serve as a co-design tool by providing an open yet structured framework that leverages a shared vocabulary among participants. In the example this could work as follows:

The teacher considers that further design phases might involve collaborating with the art teacher who could guide students in creating the game board or card illustrations. Sharing the matrix could be useful both to explain the project and receive feedback and insights.

Through this process, the creation of the game evolves into a broader educational activity, fostering co-design among students, teachers, and experts, while promoting interdisciplinary learning and collaboration.

This approach, using the Game Changing Matrix not only as a tool but also as an activity facilitator, has the potential to address both curricular and social objectives while also promoting creativity, empathy, and a spirit of collaboration. The educational play intervention described in the example supports interdisciplinary learning by integrating subjects such as biology, environmental science, and art. This integration allows students to apply theoretical knowledge in hands-on, interactive settings that enhance both understanding and retention.

Additionally, it promotes the development of critical thinking, creativity, and problem-solving skills, as students collaborate to design game elements and consider user experiences. Their active participation also boosts engagement by shifting their role from passive recipients of content to co-creators of learning. At the same time, by adapting to meet the needs of students with special educational requirements, the intervention promotes inclusivity, empathy, and social responsibility, ensuring that every learner can participate meaningfully.

Culturally, these activities serve to heighten environmental awareness, helping students understand the importance of biodiversity and sustainability in addressing global challenges. They encourage cultural creativity and expression by enabling students to design fictional ecosystems, which fosters imaginative thinking and the exploration of diverse values and perspectives.

Collaboration between teachers, students, and external experts models societal teamwork, preparing students for collective problem-solving in real-world contexts. Moreover, by emphasizing teamwork and community engagement, these activities promote active citizenship, teaching students the value of working together to achieve societal goals.

Case Study: BLUTUBE - Who brings the water home

Using the BLUTUBE project (https://www.blutubegeal.it/home/) as a case study, this paper aims to demonstrate how the Game Changing Matrix can be applied to analyze an entire ludic-educational intervention rather than focus exclusively on the design of a single game. BLUTUBE combines a board game, gamified activities, and tournaments to promote sustainable water use among children and their families, highlighting the ability of the GCM to evaluate complex, multi-layered interventions.

The BLUTUBE project was selected as a case study due to its semi-structured analysis and the availability of meaningful data concerning its social impact . In our view , this project represents a best practice with high potential for replication, demonstrating a robust synergy between play, education, and social change.

It is important to clarify that none of the authors of this contribution participated in the design of BLUTUBE or in the project itself; the analysis is based solely on information available online, including the project website and scientific publications from the 2021 edition.

Project overview and outcomes

The BLUTUBE project was launched in 2019 in Lucca (Italy) by the Provincial Education Office of Lucca, Lucca Crea s.r.l., and GEAL s.p.a., with the goal of promoting sustainable water use among children and their families. The initiative reached approximately 1000 students (grades 2–4) in three phases over eleven months (Bilancini, Boncinelli, & Di Paolo, 2023).

The first phase, titled “How not to drown in a glass of water”introduced students to the importance of water conservation through classroom sessions. Each participant received a copy of the *BLUTUBE board game* to play it both at home and at school.

The second phase, “Bring the water to your mill”, lasted six weeks and encouraged students to earn points by playing the BLUTUBE board game, visiting local "water places" (indicated in a map distributed at the beginning with the board game), and submitting photos of their sustainable practices. Points were tallied and published on a dedicated website and in local newspapers, fostering a sense of visibility and community engagement.

The third and final phase, “BLUTUBE Tournaments”, inter-class competitions involving 16 of the 53 participating classes, with a final tournament held during the 2019 edition of the Lucca Comics & Games festival.
Considering the outcomes of this intervention, the project significantly improved students' awareness of water use and increased discussions on sustainability within families. Notably, these positive effects persisted six months post-intervention.

BLUTUBE through the lens of the Game Changing Matrix

The Game Changing Matrix was used retrospectively to analyze the Blue Tube multi-layered components, highlighting its utility in evaluating complex interventions. Using the GCM the BLUTUBE project can be analyzed both as a full didactic experience as a single game/gamification activity (Figure 3).

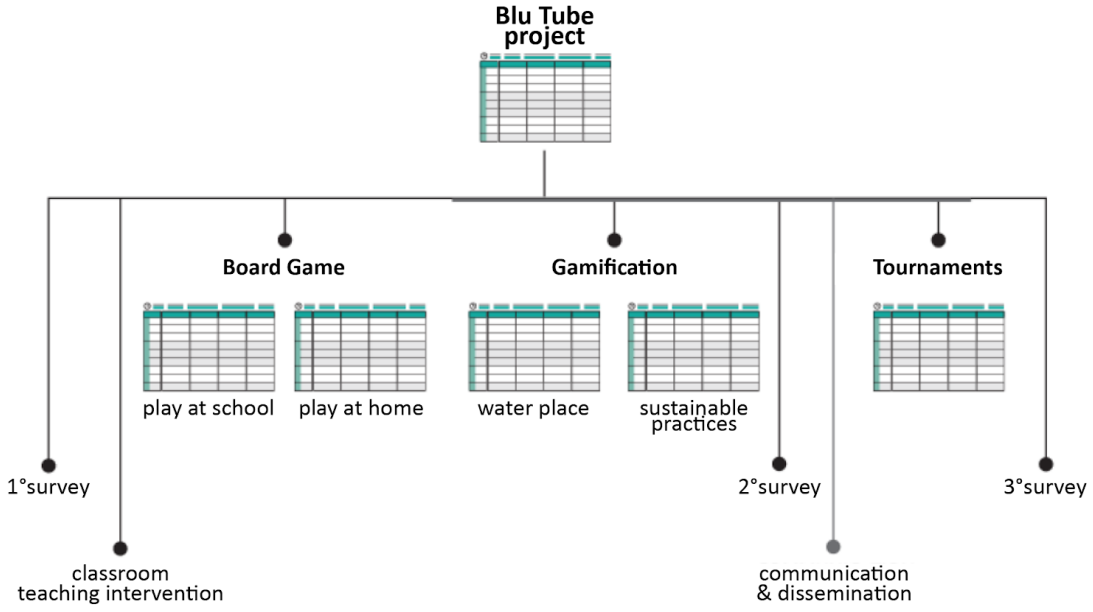


Figure 3. Application of the Game Changing Matrix along the different phases of the Blue Tube project.

Analyzing the BLUTUBE project using the Game Changing Matrix (GCM) offers a structured approach to evaluate its design, effectiveness, and areas for improvement. The following is a step-by-step breakdown of this analysis through the lens of the GCM, addressing Mechanics, Dynamics, and Aesthetics, while connecting these aspects to the overall objectives and outcomes of the intervention.

The main goals for Change can be identified as (1) to promote sustainable water use among children and their families, and (2) to foster long-term awareness and behavioral shifts in water conservation.

Timeline Overview

The intervention, which panned 11 months, was structured into three main phases:

1. Introduction and Game Distribution (lasting 2 months)
2. Gameplay, Visits, and Challenges (lasting 6 weeks)
3. Tournaments and Final Event (culmination)

Phases of experience

Through the GCM, we can identify the various stages of the experience as follows: a) 1st survey, b) in-person educational moment, c) delivery and explanation of the game, d) game activity at school, e) game activity at home, f) challenges on best practices, g) challenges on water-related places, h) 2nd survey, i) tournament, j) 3rd survey. As shown in Figure3, several of these stages can be further examined using the matrix.

The matrix enables a comparison of the intervention's three main components, highlighting their differences.

The board game focuses on learning and individual or group engagement within a controlled context. In the classroom, students apply the knowledge gained through lessons while interacting with their peers in a semi-structured format. When played at home, the game allows students to shift roles—from learners to advocates—encouraging them to promote sustainable water practices to family members.

Gamification activities expand the experience beyond the classroom and home, with tangible impacts on daily life and community awareness. Indeed, The activity on *water places* introduces a new form of interaction with the urban environment, prompting children and families to engage in acts of active citizenship that are crucial to achieving the intended social change. The activity on *best practices* consolidates the theories learned. A public ranking system, amplified through local media, reinforces behavior change by enhancing engagement and motivation, especially as the challenge intensifies toward the final phase

Finally, the tournaments reinforce knowledge and incentivize collaboration. They effectively combine educational goals with the excitement of competition, rewarding commitment and effort with public recognition.

After mapping the entire project, we can place individual activities in the matrix to analyze the design and understand which strategies were employed to promote the desired changes.

Bring the water to your mill - discover water places

As previously illustrated, the BLUTUBE project is structured across various phases and activities. To explain how these activities can be described and analyzed using the GCM, we will focus on one of the gamification activities from the second phase: "The Places of Water" (Figure 4)

The activity: students are provided with a map (also available digitally) highlighting "The Places of Water"—a curated list of water-related sites, including buildings, fountains, springs, and wells. . At each location, a panel with a QR code is installed. Over six weeks, students visit these sites with their parents and scan the QR codes. Scanning the code redirects them to a web page where they can enter their name, surname, and class to earn 150 points. These points are tracked and displayed on the project website, and also published in a local newspaper, enhancing both visibility and engagement.

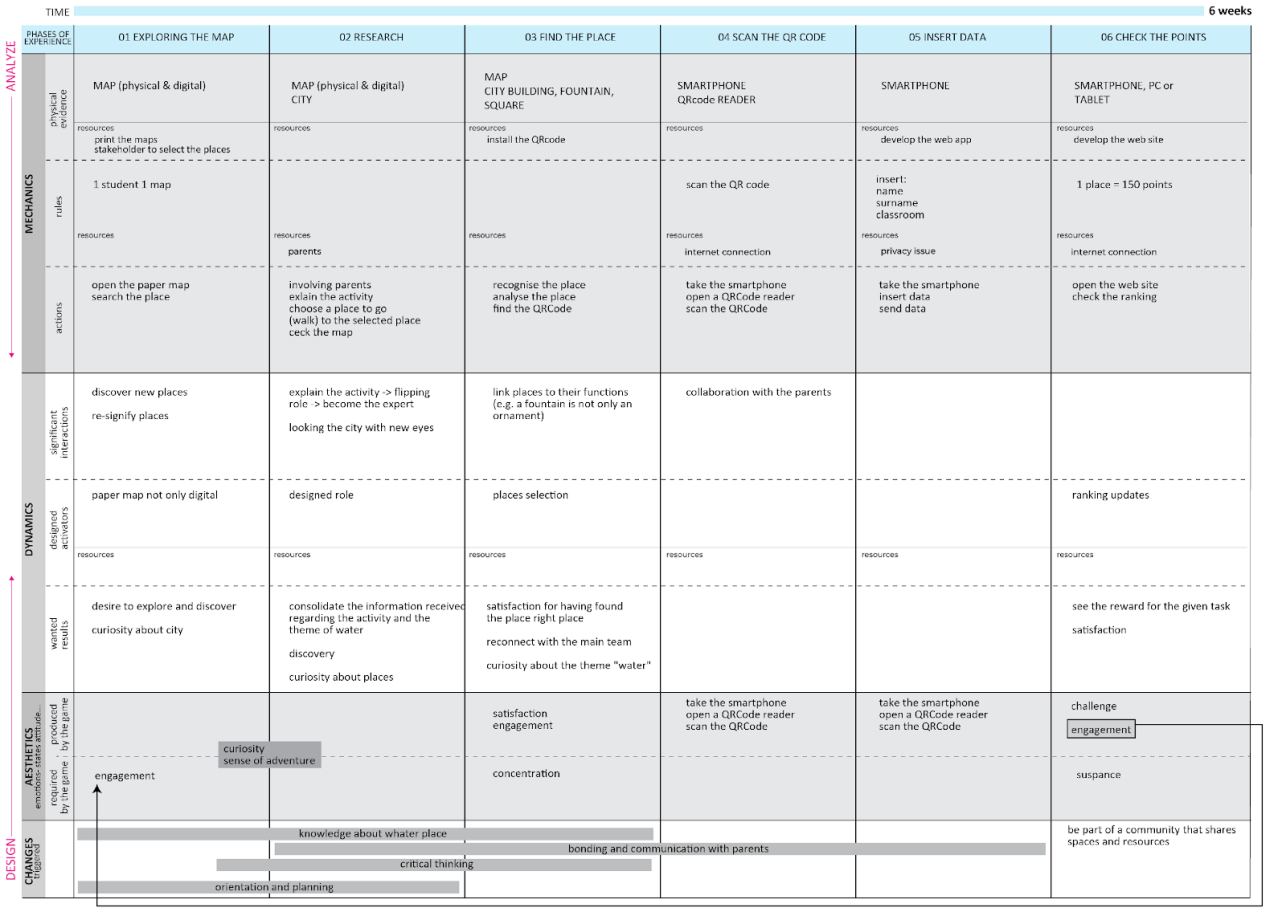


Figure 4. GCM of "Water place" gamification activity (link to HD version: https://drive.google.com/file/d/1wnMUj045Tbx2Gwr27CQ_Wh32_oGaEfK-/view?usp=sharing*).*

The *mechanics* of the activity rely on a map and QR codes as tangible tools to guide participation. These elements required external *resources*, including stakeholders to identify and select engaging locations as well as web designers to create the online platform linked to the QR codes. Students and their families visit designated sites, scan QR codes, and input their information to earn points. The simplicity of these *rules* allows participants to explore and engage with the activity at their own pace and according to their preferences. The core *action* of exploration encourages students to actively interact with their environment.

The *dynamics* are further enriched by the interactive nature of exploration that stimulates *significant interaction*s and meaningful connections between students, their families, and the urban surroundings. As *wanted result*, students gain curiosity and increased knowledge about local water-related landmarks, thereby enhancing their awareness of water resources. This outcome is achieved through *activators* such as the map and the deliberate positioning of students in a leadership role during the activity.

The activity *produced aesthetics* of excitement and satisfaction through its gamified structure, offering rewards for participation. It also necessitates curiosity and a sense of accomplishment to ensure sustained engagement. These emotional drivers make the activity both impactful and enjoyable for participants.

The overarching *change* promoted by the activity is a behavioral shift toward valuing and conserving water resources. It connects students to real-world examples, transforming abstract concepts into tangible learning experiences. By involving families, it also fosters community engagement and active citizenship, making the activity a shared journey of exploration and education.

Validation workshops and critical future development

The Game Changing Matrix is the result of a collaborative research effort, developed and tested across our game design cases. To validate this novel methodology as a practical tool to support the design of games for change, we

initiated a two-phase validation process. To this end, we conducted workshop sessions applying the GCM both to analyze existing games and to design new ones. These sessions allowed us to iteratively refine the methodology based on the feedback provided by participants.These workshops gathered together participants with diverse expertise and background: game designers and developers, researchers specializing in game-based learning and games for change, scholars using games for dissemination and public engagement, and educators and practitioners incorporating games or gamification into teaching.

To date, 10 people have been involved across 2 workshops and the version of the GCM presented in this paper reflects improvements shaped by their suggestions. Since the development of the GCM matrix is an ongoing iterative process, we continue to experiment and refine the tool through both practice and dialogue with stakeholders.

However, several limitations and future challenges must be acknowledged. One concern relates to the vocabulary used within the matrix. The field of game design does not always share consistent definitions for key terms, and the introduction of new subcategories—though intended to clarify—may risk generating confusion. Continued refinement of the terminology is essential to maintain accessibility, especially for users unfamiliar with academic or design jargon.

Moreover, the visual structure of the matrix, while inspired by tools such as journey maps, may be perceived as overly schematic or rigid by more intuitive or creative users. Although the GCM was conceived to support ideation, it might instead constrain it for those who prefer nonlinear or less structured thinking. Since the methodology originates within a design-oriented research context, further effort is needed to ensure its usability in educational or community-based environments where users may lack prior experience with design tools.

Adaptability and scalability are also key concerns. While the GCM is designed to be modular, applying it effectively across different educational levels—from primary school to higher education, or in non-formal contexts—will require support materials and strategies adapted to the specific context and audience. This includes considerations for digital literacy, classroom time constraints, and the availability of facilitation.

In addition, the workshops conducted so far—though valuable—represent only a limited sample. Broader testing across a wider range of participants and settings is necessary to assess how the tool is interpreted and used in practice. Particular attention should be paid to identifying potential biases embedded in the matrix's structure or language that may reflect the disciplinary perspectives of its developers.

To address these limitations and improve the tool, we are envisioning a digital version of the Game Changing Matrix. This will be crucial not only for improving access and ease of use, but also for enabling customization, simplifying terminology where needed, and supporting a variety of use cases. This digital tool is envisioned as a modular, accessible platform that bridges theoretical insights with practical needs—offering a structured resource for both creating and evaluating meaningful games for change.

Conclusions

The Game Changing Matrix (GCM) introduced in this paper offers a structured and accessible methodology to design and analyze games and gamified experiences. By aligning theoretical frameworks with real-world applications, the GCM aims to empower designers and educators to explore interdisciplinary collaboration, fostering innovative solutions to educational and societal challenges.

A key strength of the GCM lies in its dual functionality: it can be used to evaluate complex, multi-phase interventions as well as single activities.. This versatility was demonstrated through its application to the BLUTUBE project. The GCM enabled an in-depth evaluation of the overall intervention while also supporting focused analysis of specific components. Similarly, when applied to the design of a new game for change, the GCM helps shift between the macro-level (objectives, participants, and context) and the micro-level (resources, rules, actions, aesthetics). Its structure, categories, and open guiding questions facilitate collaborative design process by prompting critical reflections, generating ideas, and informing decisions aligned with the intended impact.

As part of our continued validation, we are developing an intuitive and user-friendly digital version of the GCM, accessible even to users without prior experience in game design. This advancement will allow a broader audience, including educators, community leaders, and students, to harness the GCM methodology for crafting impactful and engaging learning experiences.

By demystifying game design, the GCM aims at democratizing the access to design tools and promotes broader participation in creative educational innovation.

Ultimately, the GCM supports the development of purpose-driven games, while enhancing the educational process itself by promoting creativity, critical thinking, and interdisciplinary collaboration. Its potential as both a teaching tool and a practical resource highlights its value in addressing the growing demand for innovative, game-based approaches to learning and social engagement. Future developments, such as a digital version of the GCM, will further amplify its scalability and impact, cementing its role as a transformative asset in design education.

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