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Research Paper

Understanding Brainstorming in the Creative Process of Game Design: Tools, Challenges, and Perspectives from Industry Professionals

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Abstract. Brainstorming is a fundamental stage in game development, supporting the generation of ideas and the early articulation of design decisions. However, designers may face difficulties in selecting appropriate tools and in integrating player-centered concerns, such as motivation and emotion, into ideation in a structured way. This study investigates the tools and methods used during brainstorming sessions in game design, focusing on practitioners' preferences, challenges, and perceptions regarding psychological aspects in concept formation. An exploratory questionnaire-based study was conducted with participants involved in game development and prior brainstorming experience. The results indicate the use of diverse supports, including organizational platforms, visual collaboration tools, analog resources, and prototyping practices. They also suggest that, although participants recognize the importance of motivation, emotion, and player behavior, these dimensions are not yet consistently incorporated into brainstorming through structured methods or tools. The study offers an empirical overview of current brainstorming practices and points to opportunities for more structured and player-centered ideation supports.

Keywords: Game Design, Brainstorm, Psychology, Neuroscience, Creative Process, Industry Professionals

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1 Introduction

The development of digital games involves the articulation of mechanics, narrative, aesthetics, technology, and player experience within the same design process. According to Fullerton [2014], brainstorming is one of the key early activities in this process, as it enables designers to explore possibilities before production decisions become fixed. More broadly, design research describes early concept development as a stage marked by ambiguity, incomplete information, and the progressive stabilization of ideas, which makes the organization and interpretation of emergent concepts particularly relevant [Cross, 2006; Dorst, 2006; Brown, 2009].

In game design, however, early ideation does not concern only the invention of isolated mechanics, themes, or narratives [Salen, 2007; Wit, 2021]. It also involves reasoning about how systems, interactions, and representational choices may produce particular player experiences. Prior studies indicate that player motivation influences engagement patterns and gameplay preferences, while emotional responses shape how players interpret challenge, reward, uncertainty, and meaning during play [Ryan *et al.*, 2006; Przybylski *et al.*, 2010; Isbister, 2016; Carneiro *et al.*, 2022]. At the same time, game design frameworks emphasize that such experiences are structured through rules, mechanics, dynamics, aesthetics, and other formal elements of the game [Hunicke *et al.*, 2004; Schell, 2019]. Together, these perspectives support the view that design decisions in games are closely related to the motivational and emotional dimensions of player experience, rather than constituting separate concerns [Baharom *et al.*, 2014; Wit, 2021; Carneiro *et al.*, 2022].

Given this scenario, the present study investigated the tools and methods used by game designers in the industry during brainstorming sessions, focusing on their preferences, difficulties, and perceptions regarding the integration of interdisciplinary aspects. The research sought to answer questions such as: which tools are most commonly used? Which challenges are recurrent? And in what ways could Psychology and Neuroscience contribute to this process? By mapping these practices, the present study investigates the tools and methods used by game designers in the industry during brainstorming sessions, focusing on their preferences, difficulties, and perceptions regarding the integration of interdisciplinary aspects into the creative process. This study is not limited to identifying which tools are used during brainstorming, but to understanding how game designers organize ideas, deal with creative and collaborative constraints, and perceive the role of psychological knowledge in concept formation.

Although this article centers on the survey itself, the study also functions as a diagnostic stage within a broader research agenda aimed at developing a player-centered ideation artifact grounded in Game Design, Psychology, and Neuroscience. In this sense, mapping current practices is valuable not only for describing the state of brainstorming in the field, but also for identifying design requirements for future support tools.

To address these questions, this study adopted a questionnaire-based exploratory design with game

development participants who reported prior experience in brainstorming sessions. The questionnaire combined closed-ended and open-ended questions to capture both recurring tendencies and more detailed perceptions regarding tools, practices, and interdisciplinary aspects of ideation. The collected data were examined through a descriptive analysis of the structured responses and a thematic analysis of the open-ended comments. In broad terms, the results indicate that participants rely on a diverse set of brainstorming supports, including organizational platforms, visual collaboration tools, analog resources, and early prototyping practices. The findings also suggest that, while respondents recognize the importance of motivation, emotion, and player behavior in design, they still report difficulties in selecting tools and in integrating such dimensions more explicitly during early ideation.

Accordingly, this article is organized as follows. Section 2 presents the theoretical background on creativity, cognition, emotion, motivation, and game design tools. Section 3 discusses related work on creativity support in game design, emotion-centered frameworks, and structured approaches to brainstorming and ideation. Section 4 describes the methodological procedures adopted in the study. Section 5 presents the results of the survey. Section 6 discusses the findings in light of the literature, and also addresses the study's limitations and implications for future work. Finally, the last section presents the final considerations.

2 Fundamental Concepts

This study is grounded in the intersection of theories on creativity, Psychology, Neuroscience, and Game Design. More specifically, it addresses the cognitive processes involved in brainstorming, the emotional and motivational dimensions that shape player experience, and the role of frameworks and tools in supporting early design decisions. This articulation is particularly relevant in game development, where ideation does not concern only the generation of isolated ideas but also the organization of relationships between systems, intended experiences, and player-centered design goals.

2.1 Creative and Cognitive Processes in Brainstorming

Brainstorming is widely recognized as a central practice in creative problem solving and early design exploration [Brown, 2009]. In game design, it supports the initial development of mechanics, narratives, interaction structures, and experiential goals under conditions of uncertainty, where ideas are still unstable and multiple possibilities compete for attention [Fullerton, 2014; Schell, 2019]. From a cognitive perspective, this process depends on the interaction between prior knowledge, associative thinking, attention control, and evaluation, rather than on a single isolated creative ability [Amabile, 2018; Guilford, 1967; Beaty *et al*., 2014].

This helps explain why brainstorming is both productive and demanding. Divergent thinking depends on the ability to recombine known concepts into new possibilities, while convergent thinking is required to evaluate, refine, and connect these possibilities into more coherent design directions [Runco and Jaeger, 2012; Beaty *et al*., 2015]. In practice, however, these operations compete for limited cognitive resources. Studies on collaborative creativity indicate that unstructured brainstorming may suffer from cognitive overload, fixation effects, production blocking, and social inhibition, especially when participants must simultaneously generate, remember, compare, and communicate ideas [Paulus and Nijstad, 2019; Sweller, 1988].

In this context, external representations play an important role. Theories of distributed and extended cognition suggest that reasoning is not restricted to internal mental processes, but may be supported by interaction with artifacts, symbols, and material representations [Clark and Chalmers, 1998; Hutchins, 1995]. In design activities, sketches, cards, diagrams, whiteboards, and digital boards can function as cognitive scaffolds by reducing memory demands, structuring attention, and making emerging ideas visible and manipulable [Inie and Dalsgaard, 2020; Peters *et al*., 2021]. Rather than replacing creativity, these artifacts help designers coordinate it.

2.2 Psychology and Neuroscience in Creativity and Emotional Experience

Creativity involves the interaction of multiple neural and cognitive systems. According to Dietrich [2004], creative thought emerges from the coordinated functioning of different brain systems associated with spontaneous association, evaluation, salience detection, and affective processing. More recent studies reinforce that creative ideation depends on the dynamic interaction between associative processes and executive control, allowing novelty generation without losing task relevance [Beaty *et al*., 2014, 2015]. In design contexts, this means that creative performance is not only a matter of producing many ideas, but of organizing and transforming them in meaningful ways.

Within this broader cognitive landscape, emotion occupies a central position in how games are experienced. Emotional responses are part of how players interpret events, evaluate feedback, attribute meaning to challenge, and remain engaged over time [Damasio, 1994; Isbister, 2016]. For ideation, models such as Ekman's basic emotions and Plutchik's organization of primary emotions offer a practical vocabulary for discussing affective intentions, emotional contrasts, and possible trajectories during gameplay [Ekman *et al*., 1999; Plutchik, 1980]. Rather than treating emotion only as an abstract psychological category, these models can help designers ask which affective responses a game should evoke and through which situations or interactions they might emerge.

Norman's emotional design framework also contributes to this perspective by distinguishing visceral, behavioral, and reflective levels of experience [Norman, 2008]. Applied to games, this structure helps clarify that emotional experience emerges across multiple layers: from immediate sensory impressions, to the usability and controllability of interaction, to reflective interpretation and personal meaning. Thus, emotional theories are relevant not only for post hoc analysis of player experience, but also for guiding ideation by helping designers define which affective responses they

intend to elicit and through which design means.

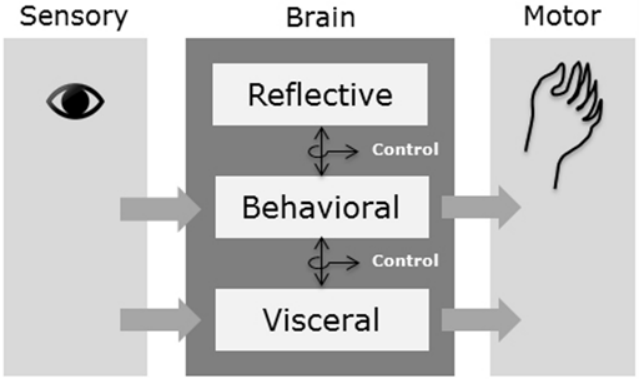

Figure 1. Emotional Design Model [Norman, 2008]

2.3 Motivation and Creativity

Motivation is a multifaceted construct that has been widely examined in Psychology and Neuroscience because it helps explain the direction, persistence, and regulation of goal-oriented behavior [Maslow and Murphy, 1954; Damasio, 1994]. In creative work, motivation is especially relevant because it influences not only whether individuals remain engaged in a task, but also how much cognitive effort they invest in exploring and refining ideas. Amabile Amabile [2018] argues that intrinsic motivation, that is, engagement driven by interest, curiosity, or enjoyment in the activity itself, is strongly associated with higher creative performance.

In game design, motivation is relevant at two levels. First, it affects the designers' own creative process, since engagement, autonomy, and challenge influence ideation quality. Second, and more importantly for this study, it helps designers reason about the kinds of goals and rewards that may sustain player engagement. Research on digital games has shown that motivational processes are closely related to autonomy, competence, achievement, exploration, social interaction, and other forms of valued participation [Ryan *et al*., 2006; Przybylski *et al*., 2010]. These dimensions influence what players seek in games and how they interpret progress, difficulty, and reward.

Player-centered motivational models are useful for design reasoning because they translate general motivational theory into categories closer to player goals and gameplay preferences. Yee's model, for example, organizes engagement around clusters such as achievement, social interaction, and immersion [Yee, 2006, 2016], while Flow Theory relates deep involvement to the balance between challenge and skill [Csikszentmihalyi, 2020]. For brainstorming, these perspectives suggest that motivation can help orient concept generation, support decisions about systems and progression, and align design intentions with expected forms of engagement.

2.4 Game Design Techniques and Tools

Frameworks and tools in Game Design play a fundamental role in helping designers reason about complex relationships between systems and experience. However, not all designs support the same function. Some frameworks are primarily analytical: they help structure thought, interpret games, and clarify relationships between design layers. Others are more operational: they are used directly in ideation and brainstorming to externalize concepts, organize alternatives, and facilitate collaborative discussion.

Among the analytical frameworks, the MDA model (Mechanics, Dynamics, Aesthetics) is one of the most influential because it relates formal system components to player experience [Hunicke *et al*., 2004]. Similarly, Schell's Elemental Tetrad organizes games in terms of mechanics, narrative, aesthetics, and technology, offering a broad lens for examining design interdependencies [Schell, 2019]. These frameworks are highly useful for framing design problems and reflecting on experiential outcomes, but they do not necessarily provide concrete procedures for conducting brainstorming sessions or for transforming abstract categories into ideation prompts.

Operational tools address this gap in a different way. Card decks, canvases, maps, diagrams, whiteboards, collaborative platforms, and structured prompts are examples of artifacts that support ideation by making design elements more tangible and combinable [Inie and Dalsgaard, 2020; Ho and Tomitsch, 2019]. Their value lies in helping designers move from conceptual understanding to practical manipulation. In early design stages, such tools can support divergent thinking while also introducing enough structure to prevent ideation from becoming diffuse or cognitively overwhelming.

In game design, this distinction is important because early concept formation requires both conceptual lenses and actionable supports. A framework such as MDA may help designers analyze the relationship between mechanics and aesthetics, but brainstorming tools are needed to turn such reflection into shared and generative activity. Similarly, psychological and experiential concepts become more useful for ideation when they are translated into practical prompts for discussion and decision-making [Callele *et al*., 2009; Baharom *et al*., 2014; Ricchiuti, 2022]. This articulation is central to the present study, since the problem investigated is not only which tools designers use, but how such tools may support, or fail to support, the structured integration of player-centered knowledge into early game conception.

3 Related Works

Research related to the present study can be organized into four complementary fronts: methods that support creativity and brainstorming in game design, structured design methods for serious and persuasive games, frameworks that explicitly incorporate emotion into the design process, and studies that examine the availability of frameworks connecting psychological dimensions to game design.

One relevant line of work concerns methods created to support creativity during early game design. Possamai, Hounsell and Gasparini [Possamai *et al*., 2021] proposed the ABCDE methodology to foster creativity in the conceptual stage of serious game design, particularly in the generation of game mechanics. In this direction, Ho and Tomitsch [2019] investigated the affordances of brainstorming toolkits in game jams, showing how structured materials can support ideation, collaboration, and the externalization of design

possibilities in time-constrained creative contexts. Their approach aligns creativity models with brainstorming tools in order to stimulate convergent and divergent thinking, and their evaluation suggests that the method can support the production of creative mechanics while requiring less time and fewer people than an alternative process. In a more domain-specific direction, Oliveira, de Classe and Castro [Oliveira *et al*., 2023] proposed CaSEJ, a game design canvas intended to support brainstorming for games for health. The tool helps organize ideas visually during concept formation and was evaluated through interviews with game designers and mental health professionals, who considered it useful and viable for discussing and structuring ideas in that context. These two studies are important because they show that brainstorming in game design can benefit from structured supports, but they focus mainly on creativity support and domain organization rather than on the explicit integration of emotional and motivational dimensions in early ideation.

Another relevant contribution comes from structured design methods developed for serious or persuasive games. Siriaraya *et al*. [2018] proposed a cookbook method for Persuasive Game Design, organized around the metaphor of a meal composed of design stages, components to be considered, and tools or techniques that designers may use according to context and available resources. This work is important to the present study because it exemplifies an effort to translate theoretical and methodological knowledge into a practical and flexible support for game design. However, its scope differs from the focus of this article: while the cookbook method addresses the broader process of persuasive game design, the present study investigates current brainstorming practices and the perceived need for more explicit integration of player-centered psychological dimensions during early concept formation.

A second line of work brings emotional aspects more directly into the design process. Baharom, Tan and Idris [Baharom *et al*., 2014] proposed a player-centric emotional design framework for games, emphasizing the role of emotion in pre-production and arguing that designers should plan game elements in relation to players' emotional responses. More recently, Croissant, Schofield and McCall [Croissant *et al*., 2023] reviewed work from psychology, design, and human-computer interaction to clarify the use of emotions in games and proposed a methodological framework for emotion-adaptive games. Their contribution is especially relevant because it provides both conceptual grounding and a practical process for incorporating emotion into game development. However, although these studies clearly demonstrate the importance of emotion as a design concern, they are not primarily focused on brainstorming practices or on the combined treatment of emotion and motivation during early ideation sessions.

A third contribution comes from the literature mapping conducted by D'Andrea, de Classe and Siqueira [D'Andrea *et al*., 2025], which investigated frameworks of game design based on motivation and emotion. Their systematic mapping identified 502 studies, of which only 8 met the selection criteria, and the results indicated the predominance of established frameworks such as MDA, alongside a gap in methodologies that integrate emotional and motivational aspects more effectively into game design. This finding is particularly relevant to the present study because it reinforces that, although motivation and emotion are recognized as important dimensions of player experience, there are still relatively few structured approaches that bring these dimensions together in a practical way for design work.

A related contribution from the Brazilian Digital Games research community is the systematic mapping by Carneiro *et al*. [2022], which examined studies on player profiles, motivations, behavior, and personality characteristics. Their work is relevant to the present study because it reinforces the importance of understanding player-centered psychological dimensions in game design, while also showing that such constructs have been investigated as part of the broader effort to characterize player experience.

These related works indicate that the literature already offers relevant advances in creativity-oriented methods, domain-specific brainstorming supports, structured design methods, and emotion-centered game design frameworks. However, they also suggest that there is still limited work at the intersection of brainstorming practice, motivation, emotion, and early game conception. It is precisely in this space that the present article is positioned. Rather than proposing a new artifact directly, this study investigates how game designers currently conduct brainstorming, which tools they use, which difficulties they report, and how they perceive the value of psychological knowledge in ideation. In this sense, the article contributes empirical evidence that can inform the design of more structured and player-centered brainstorming supports in future work.

4 Study Methodology

This study employed an exploratory questionnaire to investigate the tools and methods used by game designers in the game industry during brainstorming sessions for game development. The main objective was to identify recurring practices, perceived benefits, difficulties, and expectations regarding tools used in early ideation. More specifically, the study sought to generate empirical evidence on how practitioners organize brainstorming activities and how they perceive the relevance of interdisciplinary aspects, especially those related to Psychology and Neuroscience, in concept formation.

Methodologically, the study should be understood as exploratory and diagnostic in nature. Rather than testing hypotheses or seeking statistical generalization, the questionnaire was designed to obtain an initial and situated understanding of a practical problem observed in game design: the challenge of organizing ideas and relating creative decisions to player-centered concerns during brainstorming. In this sense, the survey also constitutes an early empirical stage within a broader research agenda aimed at informing the future development of a brainstorming support artifact grounded in Game Design, Psychology, and Neuroscience. This diagnostic role is consistent with exploratory studies whose purpose is to clarify phenomena, identify relevant variables, and support subsequent research and design decisions [Creswell and Creswell, 2017; Trivisios, 1987].

To capture both structured tendencies and richer perceptions from participants, the questionnaire combined closed-ended and open-ended questions. This combination is relevant in exploratory studies because closed-ended questions help organize responses into comparable categories, while open-ended questions allow participants to elaborate on experiences, justify choices, and introduce nuances that predefined alternatives might not capture [Oliveira *et al*., 2021; Creswell and Creswell, 2017]. In the present study, closed-ended questions were used mainly to characterize participants, identify frequency of brainstorming participation, map the most commonly used tools, and capture perceived importance assigned to psychological aspects. Open-ended questions, in turn, were used to collect examples, justifications, and suggestions regarding the use of tools, challenges faced during brainstorming, and perceptions about the possible value of more structured player-centered supports.

The questionnaire (Table 1) included items concerning participant profile, professional role, years of experience, organizational context, frequency of brainstorming participation, tools and methods used, perceived benefits and limitations of such tools, desired characteristics in brainstorming supports, and perceptions regarding the relevance of human behavior, motivation, and emotion in game design. In addition, some questions invited respondents to justify their answers in their own words, making it possible to complement the descriptive results with qualitative evidence directly grounded in participant discourse.

It is important to note that terms such as human behavior, motivation, and emotion were presented in the questionnaire in broad and accessible language, accompanied by examples such as rewards, progression, achievement, socialization, and player emotions. The intention was not to assess participants' formal knowledge of psychological or neuroscientific theories, but to capture how they perceive the practical relevance of these dimensions in game design brainstorming.

Before data collection, the questionnaire was reviewed by two specialists in Game Design, who evaluated the clarity, relevance, and adequacy of the questions in relation to the objectives of the study. Based on their feedback, minor adjustments were made to improve the wording and organization of the instrument. Although no pilot study was conducted, this expert review served as a preliminary validation step before the questionnaire was applied.

The questionnaire was created using Google Forms and distributed through online channels aimed at game designers, including forums and social media groups on Facebook, WhatsApp, LinkedIn, Discord, and e-mail. The recruitment message presented the study objective, the target audience, the estimated time required to complete the questionnaire, and the voluntary nature of participation. Participants were eligible if they had experience in game development and had previously participated in brainstorming sessions. However, the exact number of communities contacted and the number of individuals who viewed the invitation were not systematically recorded, which prevented the calculation of an overall response rate.

This strategy was chosen because it enabled access to a relevant target audience composed of practitioners with direct experience in game development and brainstorming activities. The recruitment process therefore followed a non-probabilistic and intentional logic oriented by participant relevance to the phenomenon under investigation, rather than by statistical representativeness [Creswell and Creswell, 2017; Trivisios, 1987]. Data collection lasted two days and resulted in 8 valid responses. All respondents reported experience in game development and prior participation in brainstorming sessions, which was important for ensuring that the answers reflected situated professional or semi-professional practice.

Regarding ethical procedures, this study was conducted with attention to principles of voluntary participation, informed consent, confidentiality, and responsible data management. Before completing the questionnaire, participants had access to an informed consent form (ICF), which explained the study's objective, the voluntary nature of

Table 1. Questionnaire questions

ID	Question	Type
Q1	What is your main role in game development?	Required multiple choice
Q2	How long have you been working in game development?	Required multiple choice
Q3	What type of organization do you work in?	Required multiple choice
Q4	How often do you participate in brainstorming sessions for new games or features?	Required multiple choice
Q5	Which tools or methods do you use most often during brainstorming? (Select all that apply)	Required multiple choice
Q6	If you selected the last option in the previous question, please specify which techniques you use.	Optional open-ended question
Q7	Which of the tools listed above do you consider the most efficient for generating innovative ideas? If possible, please justify your answer.	Required open-ended question
Q8	What are the main benefits you perceive when using tools in brainstorming? (Select all that apply)	Required multiple choice
Q9	What challenges or limitations do you face when using tools for brainstorming? (Select all that apply)	Required multiple choice
Q10	What characteristics do you consider essential in a good brainstorming tool for game design?	Optional open-ended question
Q11	How important do you consider the application of knowledge about human behavior (e.g., motivation, rewards, emotions) for creating engaging games?	Required multiple choice
Q12	In your design decisions, do you consider the emotions the player will feel throughout the experience?	Required multiple choice
Q13	How important is it to understand players' motivations (e.g., progression, achievement, socialization) when planning a new game or feature?	Required multiple choice
Q14	If you wish, please justify your answer above	Optional open-ended question
Q15	Are you familiar with or have you ever used any specific Psychology or Neuroscience framework or theory applied to Game Design? (e.g., Motivation Theories, Octalysis, MDA, etc.)	Required multiple choice
Q16	If you selected yes previously, which tool do you know or use?	Optional open-ended question
Q17	Do you believe that a Game Design tool that includes aspects of Psychology and Neuroscience (to map player emotions, motivations, and behaviors) would be useful?	Required multiple choice
Q18	Is there any experience or insight you would like to share about the use of brainstorming tools in game development?	Optional open-ended question

participation, and how their responses would be used for research purposes. Participation in the questionnaire was considered an indication of consent.

The study involved minimal risk to participants, since it consisted only of a questionnaire about professional practices and perceptions related to brainstorming in game development. No intervention, experimental manipulation, or collection of sensitive personal data was conducted. The questionnaire did not require personally identifiable information as part of the main responses. At the end of the questionnaire, participants could optionally provide an e-mail address if they wished to receive the results of the study or be contacted about future developments of the research. This contact information was used exclusively for these purposes, was not considered in the analysis, and was not reported in the results.

Confidentiality was preserved during analysis and reporting by summarizing the results and anonymizing the discursive responses presented in the article. The questionnaire data were stored in a restricted-access spreadsheet and used only for research purposes. In reporting the findings, responses were presented in aggregated or anonymized form, avoiding the disclosure of information that could identify individual participants.

The collected data were exported to a spreadsheet[1] and analyzed through a combined quantitative and qualitative procedure. The closed-ended questions were examined descriptively in order to summarize the profile of respondents and identify the recurrence of tools, practices, and perceptions across the sample.

The open-ended responses were analyzed through an exploratory thematic procedure. First, all responses were read in full to obtain an overview of the material. Then, excerpts expressing relevant ideas were identified and grouped according to recurring themes (categories) aligned with the objectives of the study, such as commonly used tools, perceived benefits, practical limitations, desired features in brainstorming tools, and views on the relevance of psychological and neuroscientific concepts in design. These categories were then reviewed in relation to the research questions in order to support the interpretation of the findings. Although the analysis did not follow a fully formalized coding protocol or independent validation process, this thematic organization was important for systematizing the material and making interpretive patterns more explicit, which is consistent with qualitative procedures that seek to identify recurrent meanings in textual responses [Braun and Clarke, 2006].

This analytical strategy was considered adequate for the scope of the study because it allowed the integration of two complementary forms of evidence: numerical tendencies derived from the structured questions and interpretive insights derived from the open-ended responses. As a result, the methodology made it possible not only to describe which tools are more frequently used, but also to better understand why certain tools are perceived as useful, what kinds of constraints participants report in practice, and how they interpret the potential role of player-centered psychological knowledge during ideation.

[1]Data: `https://doi.org/10.6084/m9.figshare.32024229`

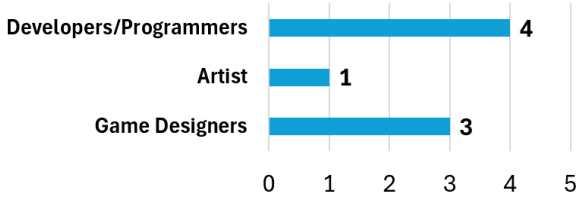

Figure 2. Participants' work.

Although the number of respondents is limited, this does not invalidate the study's contribution, since the goal was exploratory rather than inferential. In qualitative and exploratory investigations, relevance is associated less with sample size alone than with the pertinence of participants to the phenomenon being investigated and with the richness of the information collected [Trivisios, 1987; Creswell and Creswell, 2017]. Thus, the methodological value of the questionnaire lies in offering an initial empirical map of practices and perceptions that can support subsequent analytical developments and future design interventions.

5 Study Results

This section presents the survey results in relation to the research questions and the questionnaire items listed in Table 1. Because the study is exploratory, the analysis combines descriptive evidence from the closed-ended questions with thematic interpretation of the open-ended responses. The qualitative evidence complements the descriptive results by illustrating recurrent perceptions, reported practices, and perceived challenges identified in participants' comments. To make the analytical path more explicit, Table 2 summarizes how each block of results is connected to the research questions and to the questionnaire items that generated the evidence discussed in this section.

5.1 Participant Profile

This subsection provides contextual information for the interpretation of the survey results. The questions used in this block addressed participants' professional role, years of experience, organizational context, and frequency of participation in brainstorming sessions. Although these items do not answer a research question directly, they help situate the evidence discussed in the following subsections by indicating from which types of participants the reported practices and perceptions emerged.

The survey collected responses from **8 participants** with relevant experience in game development. Four (4) identified themselves as Programmers, 1 as an Artist, and 3 as Game Designers (Figure 2). Regarding years of experience, 1 participant reported less than 1 year of experience, 1 reported between 1 and 3 years, 2 reported between 4 and 6 years, 3 reported between 7 and 10 years, and 1 reported more than 10 years of experience (Figure 3). As for the type of organization in which they work, 1 participant stated that they do not work professionally in the field, 3 work in independent studios, and 4 reported working in medium- or large-sized companies (Figure 4). Regarding the frequency with which they participate in brainstorming sessions for new games or game features, 1 participant stated that they participate daily, 1 weekly, 4 monthly, and 2 rarely (Figure 5).

Table 2. Analytical map relating research questions, questionnaire items, and result subsections

Research question	Questionnaire items (Table 1)	Result subsection
RQ1. Which tools are most commonly used in brainstorming sessions?	Questions on frequency of participation in brainstorming sessions; tools and methods used; specific techniques reported by respondents	Participant Profile; Use of Tools in Brainstorming; Tools and Methods Most Frequently Used
RQ2. Which challenges are recurrent in brainstorming practice?	Questions on perceived benefits of brainstorming tools; practical difficulties and limitations; essential characteristics of a good brainstorming tool	Perceived Benefits and Practical Limitations; Analog and Digital Tools as Complementary Supports
RQ3. How might Psychology and Neuroscience contribute to brainstorming and concept formation?	Questions on the importance of human behavior, player motivation, and player emotions; prior use of frameworks; perceived usefulness of a Psychology- and Neuroscience-informed tool	Considerations on Psychological Aspects in the Creative Process

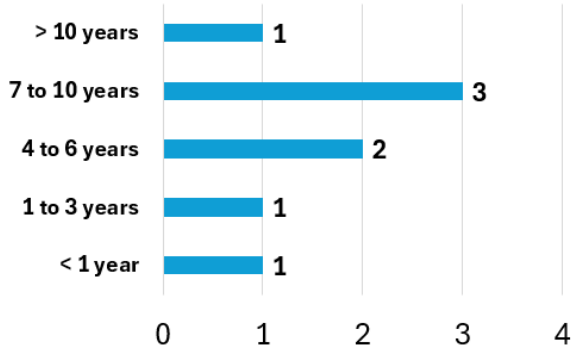

Figure 3. Years of experience.

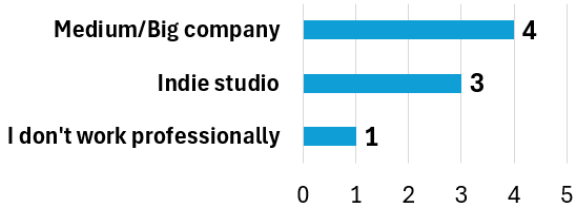

Figure 4. Organization in which they work.

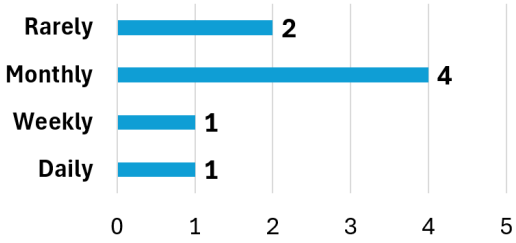

Figure 5. Frequency of brainstorming sessions.

Although the sample is small, its composition is analytically relevant because it includes participants from different roles, levels of experience, and organizational contexts. This moderate diversity is relevant in an exploratory study because brainstorming practices may vary according to disciplinary background and production context, not only individual preference. Programmers, artists, and game designers may approach ideation with different priorities, while professionals working in independent studios, larger companies, or non-professional settings may differ in how formalized their creative processes are.

The distribution of experience levels is also noteworthy. Most respondents reported at least four years of experience, suggesting that a substantial part of the sample had already participated in repeated ideation cycles and was therefore able to reflect not only on isolated sessions, but on recurring practices. At the same time, the presence of less experienced respondents contributes to capturing a wider range of familiarity with tools, from more improvised approaches to more structured collaborative practices.

The profile of participants suggests that the questionnaire captured perspectives situated at different points of the game development pipeline. Rather than representing a homogeneous professional group, the sample reflects a small but heterogeneous set of participants whose responses offer useful indications about how brainstorming is perceived across distinct roles and contexts. In this sense, the results should be read not as representative of the entire industry, but as exploratory evidence of practices and concerns that emerge in a moderately diverse group of game development participants.

5.2 Use of Tools in Brainstorming

This subsection addresses RQ1 and RQ2 by examining the questionnaire items related to the tools and methods used in brainstorming, the benefits attributed to them, the practical limitations reported by respondents, and the characteristics considered essential in a good brainstorming support. Rather than treating these answers as a simple inventory of tools, the analysis seeks to understand what kinds of cognitive and collaborative functions these supports appear to fulfill in practice.

5.2.1 Tools and Methods Most Frequently Used

To address RQ1, the questionnaire asked participants which tools or methods they use most frequently during brainstorming and, when applicable, which specific game design techniques they employ. The results indicate that brainstorming practices are distributed across organizational platforms, visual collaboration environments, analog supports, and more structured conceptual techniques. Table 3 summarizes the main categories reported by respondents, while Table 4 details specific methods mentioned in the open-ended answers.

Participants reported a wide variety of tools used during brainstorming. Among the most cited were project management and organization platforms, such as Trello, Notion, and Jira, which appeared frequently as supports for structuring ideas, tasks, and project information. Online collaboration tools, such as Miro and Figma, were also recurrently mentioned, especially in relation to real-time interaction, visual arrangement of ideas, and collaborative editing.

A first relevant group of tools, therefore, concerns *management and organizational supports*. These include project management software and note-taking applications, which were valued mainly for helping participants record,

Table 3. Categories of tools and methods reported by participants for brainstorming (n=8)

Tool / method category	n	%
Project management software (e.g., Trello, Notion, Jira)	6	75.0
Online collaboration tools (e.g., Miro, Mural, Figma)	6	75.0
Whiteboard or paper	4	50.0
Note-taking applications (e.g., Notion, Evernote, Google Keep)	4	50.0
Game design-specific techniques	4	50.0
Creative thinking techniques (e.g., Canvas, Design Thinking, Brainwriting)	2	25.0
Analog tools (e.g., card decks, board games)	1	12.5

structure, and revisit ideas. In the responses, such tools appear less as generators of novelty in themselves and more as supports for preserving coherence and visibility in the ideation process. This is consistent with the idea that brainstorming in game design is not limited to generating ideas, but also depends on organizing emerging concepts so that they can be discussed, evaluated, and developed further.

A second group concerns *visual collaboration tools*, such as Miro, Figma, whiteboards, and other shared editing spaces. These were often associated with real-time collaboration, collective discussion, and the possibility of combining textual and visual elements in a single environment. In practical terms, participants' comments suggest that these tools are useful not only because they allow many people to contribute at once, but because they make thought processes visible to the group. This visibility is especially important in brainstorming contexts, where partial ideas, sketches, references, and comments often need to coexist before a more stable concept emerges.

A third group comprises *analog methods*, such as paper, pens, physical whiteboards, and even card-based resources. These methods remained relevant in the responses, especially for face-to-face sessions. One participant explicitly mentioned the use of a gamification card deck called *Adding Play* as a useful support for stimulating creativity in a more tangible manner. The persistence of these methods in the sample suggests that physical tools still play an important role when immediacy, flexibility, and low friction are valued. In other words, participants do not necessarily abandon analog supports when digital tools are available; instead, they appear to mobilize them when the pace and materiality of the session favor direct manipulation of ideas.

A fourth group concerns *prototyping and concept validation strategies*. Although not always described as formal brainstorming tools, some respondents mentioned slide presentations, quick concept demonstrations, and initial prototyping as practical ways to test whether an idea is understandable, promising, or worth refining. This is relevant because it shows that, for some participants, ideation is already intertwined with early validation. In such cases, brainstorming is not treated as a completely separate stage from prototyping, but as an activity that benefits from quick externalization and feedback.

In addition to these more recurrent categories, some respondents mentioned more specific references for game ideation, namely the SEA Method (Feeling, Experience, Audience), the Morphological Box, Zero-Sum, and Nash Equilibrium. Although these did not appear with the same frequency as project management or collaboration tools, they are analytically relevant because they indicate attempts to introduce more explicit conceptual structures into brainstorming.

Table 4. Specific techniques reported by participants under game design-specific methods

Specific technique	How it appeared in the responses
SEA Method	Mentioned as "Feeling, Experience, Audience"
Morphological Box	Mentioned as a structured ideation technique
Zero-sum / Nash equilibrium reasoning	Mentioned as conceptual references for game design reasoning
Notebook + digital transfer workflow	Ideas first registered on paper and later transferred to digital documents or visual references
Market analysis / reference gathering	Mentioned as a complementary source of inspiration and comparison

The SEA Method, cited by one respondent as *Feeling, Experience, Audience*, appears to organize ideation around three guiding questions: what the designer wants the player to feel, what kind of experience should be created, and for whom the game is being designed. Even when used informally, this type of structure is important because it shifts brainstorming away from mechanics alone and toward the relation between affective intention, experiential framing, and target audience.

The Morphological Box, in turn, corresponds to a more structured combinatorial creativity technique. Its relevance to brainstorming lies in helping designers systematically explore permutations of mechanics, themes, progression systems, goals, or interaction features, rather than relying only on spontaneous association.

The mentions of Zero-Sum and Nash Equilibrium are also noteworthy because they suggest the use of game-theoretic reasoning as part of ideation. In game design terms, these concepts may operate less as brainstorming techniques in the narrow sense and more as analytical lenses for thinking about conflict structure, strategic balance, payoff stability, and player interdependence in competitive systems. Their appearance in the responses therefore suggests that some participants bring balancing and strategic reasoning into brainstorming from the earliest stages of concept formation.

The findings indicate that the reported tools do not serve a single function. Instead, they support different aspects of brainstorming, such as organizing information, enabling collaboration, externalizing ideas, encouraging creativity, and testing conceptual clarity. Thus, the data suggest that participants are not merely choosing between tools, but between different forms of cognitive, collaborative, and conceptual support during ideation.

5.2.2 Perceived Benefits and Practical Limitations

To address RQ2, the questionnaire investigated both the benefits participants associate with brainstorming tools and the practical difficulties they encounter when using them. This block is important because it helps explain not only which tools are used, but also why they are valued and where they fail to support the ideation process effectively. Tables 5 and 6 summarize the main benefits and limitations reported

in the sample.

Table 5. Main benefits perceived in the use of brainstorming tools (n=8).

Perceived benefit	n	%
Better organization of ideas	7	87.5
Stimulates creativity	6	75.0
Supports teamwork	6	75.0
Real-time collaboration	6	75.0
Generates ideas that would not have emerged otherwise	5	62.5
Helps overcome creative block	4	50.0

When asked about the main benefits of using tools during brainstorming, participants most frequently pointed to idea organization, collaboration in real time, creativity stimulation, support for teamwork, and the generation of ideas that might not have emerged otherwise. These responses suggest that tools are perceived as useful not only because they make brainstorming more manageable, but also because they help expand the range of associations available during the session.

This is an important point. The perceived benefits reported by respondents indicate that brainstorming tools are not being valued merely as containers of information, but as mediators of creative work. In some cases, the emphasis falls on organization and clarity; in others, on collaboration and collective ideation; and in others still, on creativity support and overcoming blocks. Therefore, the responses point to distinct but complementary functions: some tools reduce friction in managing ideas, while others enhance interaction, comparison, and the emergence of alternatives.

Table 6. Main difficulties reported in the use of brainstorming tools (n=8).

Reported difficulty	n	%
Identifying which tool to use and when	4	50.0
Maintaining focus during collaborative dynamics	2	25.0
Learning curve	1	12.5
Functionality limitations	1	12.5
No prior use of a specific brainstorming tool for games	1	12.5

At the same time, the reported challenges reinforce that tool adoption is not straightforward. The main difficulty identified by participants was determining which tool to use and at what moment in the process. Maintaining focus during collaborative dynamics was also mentioned, along with learning curve and functional limitations. One respondent further stated that they had never used a specific brainstorming tool in the context of game development.

These difficulties are analytically relevant because they suggest that the problem faced by participants is not simply the presence or absence of tools, but the lack of clearer alignment between tool affordances and ideation needs. In other words, the challenge is less about access and more about orchestration. Some tools may be powerful but too complex, while others may be simple but insufficiently structured for collaborative or player-centered reflection. This tension also appears in the desired characteristics listed by respondents, which emphasized ease of use, collaboration in real time, integration with other platforms, visual-textual combination, and support for creativity without making the user struggle with the tool itself.

When asked about the characteristics considered essential in a good brainstorming tool for Game Design, participants responded as shown in Table 7, revealing a diverse but coherent set of expectations centered on usability, flexibility, and collaborative support.

Table 7. Essential characteristics for brainstorming tools

Responses
Connectivity
Drawing features, project organization through labels. Combination of text, visual, and documentary elements.
Real-time collaboration capability, organization tools, integration with other platforms and software, and ease of access.
Real-time collaboration nowadays in the home-office and digitalized world is something that cannot be missing. Insertion of images, charts, cards, and texts would be basic. Templates that help apply the methods easily would be the differentiator.
It is fundamental for it to be easy to use
Helping creativity and the freedom to work on the idea rather than on the tool
Countless tools that can meet the user's needs down to the smallest details. Tools that will not always be used, but if we need them, they will be there

These responses indicate that the usefulness of a brainstorming tool depends not only on what it allows users to do, but also on how naturally it fits the rhythm of idea generation and discussion. In this sense, the participants' comments suggest that a good tool should support thought rather than compete with it.

5.2.3 Analog and Digital Tools as Complementary Supports

In addition to identifying which tools are used, the responses also allow a more interpretive comparison between analog and digital supports. This subsection revisits the questionnaire items on tools, benefits, and open comments to examine whether participants perceive these supports as alternatives or as complementary resources within the same ideation process.

Another relevant pattern in the responses is the coexistence of analog and digital methods. Rather than indicating a transition from one to the other, the data suggest complementarity. Digital tools were frequently associated with remote collaboration, persistent organization, and shared editing, while analog methods were associated with immediacy, ease of use, and fluidity in face-to-face interaction. This distinction is especially visible in respondents who valued collaborative whiteboards and Figma for team ideation, but also emphasized paper, pens, physical presence, or low-friction sketching as more effective in certain moments.

This coexistence suggests that brainstorming in game development may benefit from hybrid practices. Digital tools can support continuity, documentation, and distributed participation, whereas analog tools may reduce interface friction and facilitate faster externalization in synchronous sessions. Therefore, the contrast between analog and digital methods should not be interpreted as a matter of substitution, but as an indication that different stages and contexts of ideation may demand different material supports.

A similar pattern appears in responses that connect

efficiency not to a single platform, but to the interaction between people, tools, and setting. One respondent explicitly noted that the main factor is not the tool itself, but the people involved, while another highlighted the value of age-diverse teams for producing different perspectives. These comments reinforce that brainstorming tools should be understood as part of a broader collaborative ecology, where material supports, group composition, and interaction dynamics jointly shape the quality of ideation.

The responses suggest that analog and digital supports are not perceived as mutually exclusive, but as complementary resources mobilized according to the rhythm, context, and collaborative configuration of brainstorming sessions.

5.3 Considerations on Psychological Aspects in the Creative Process

This subsection addresses RQ3 by analyzing the questionnaire items related to the perceived importance of human behavior, motivation, and emotion in game design, as well as respondents' familiarity with frameworks from Psychology or Neuroscience and their openness to tools that incorporate such dimensions. The goal of this block is not only to describe whether these aspects are valued, but also to examine whether they appear to be explicitly integrated into brainstorming practice. Table 8 synthesize the main tendencies identified in this block.

Table 8. Summary of responses related to psychological aspects in game design (n=8).

Dimension investigated	Main response	%
Importance of knowledge about human behavior	Fundamental	62.5
	Important	37.5
Importance of understanding player motivations	Fundamental	75.0
	Important	25.0
Consideration of player emotions in design decisions	Always	50.0
	Most of the time	50.0
Prior use of Psychology/Neuroscience-related framework	Yes	25.0
	No, but interested	75.0
Usefulness of a tool including Psychology and Neuroscience aspects	Yes, it would bring benefits	37.5
	Maybe, but open to trying it	62.5

When asked how important they consider the application of knowledge about human behavior, such as motivation, rewards, and emotions, for the creation of engaging games, 5 participants stated that they considered it fundamental, while 3 of them considered it important (Figure 6). When asked about the importance of understanding players' motivations, such as progression, achievement, or socialization, when planning a new game or feature, 6 participants stated that they considered it fundamental and 2 participants considered it important (Figure 7). Regarding whether they consider the emotions that players may feel during the experience in their design decisions, 4 participants stated that they always consider them and the other half (4 participants) stated that they consider them most of the time (Figure 8).

A first relevant point in these results is the absence of dismissive responses regarding the role of emotions and motivations in design. None of the participants classified

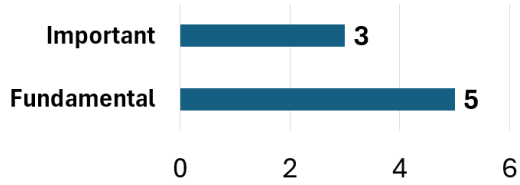

Figure 6. How important is it to apply knowledge about human behavior?

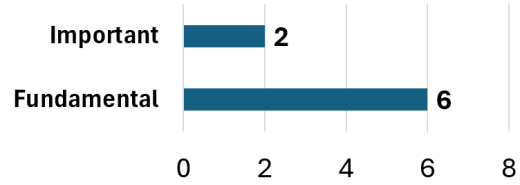

Figure 7. How important is it to understand players' motivations?

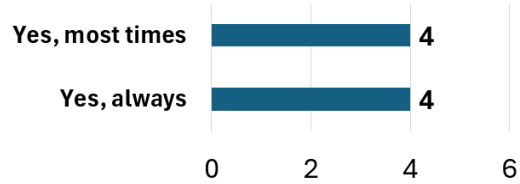

Figure 8. How often do they consider players' emotions in the design process?

these aspects as secondary or irrelevant. Even in a small exploratory sample, this pattern is noteworthy because it suggests a broad recognition that player experience cannot be fully addressed only through mechanics or content in isolation. Instead, respondents appear to understand that engagement depends, at least in part, on how players interpret goals, rewards, progress, and emotional stimuli throughout play.

The open-ended responses reinforce this interpretation. Some participants justified their answers by explicitly linking emotional experience to the very purpose of games. One respondent stated: *"Every game has entertainment as its main objective. There is no quality entertainment without evoking emotions. Whether in a film or a sports game, it is emotions that create a good experience. In addition to emotions, I would also add applied knowledge."* Another participant emphasized that *"A game will only be engaging if it somehow sparks the player's interest."* A third respondent wrote: *"My game design works by having a model of what the standard player knows and thinks at that moment, and creating a design that makes use of those thoughts."* These comments may indicate that at least part of the sample does not treat motivation and emotion as abstract theoretical constructs, but as practical lenses for anticipating how players may perceive and value the experience.

At the same time, the responses also reveal an important contrast between *recognized importance* and *formalized use*. Two respondents stated that they had already used some specific framework or theory from Psychology or Neuroscience applied to Game Design, citing the MDA framework and the Octalysis gamification framework. Six respondents stated that they had not used any such framework, but were interested in doing so. This distribution suggests that the relevance of psychological aspects is broadly acknowledged, but that explicit theoretical operationalization remains limited across the sample.

This contrast is analytically significant. On the one hand, participants seem to value motivation, rewards, behavior, and emotions as relevant to good design. On the other hand, most do not report using formal frameworks to incorporate these dimensions in a structured way during ideation. In practical terms, this may indicate that player-centered reasoning is often present in an intuitive or implicit form, rather than being consistently supported by shared methods or tools. Thus, the issue is not necessarily lack of interest, but a possible gap between conceptual relevance and procedural integration.

Participants' responses about the possible usefulness of a Game Design tool incorporating aspects of Psychology and Neuroscience reinforce this interpretation. When asked about the value and usefulness of such a tool, 3 participants stated that they believed it would bring benefits, while 5 participants stated that it might bring benefits and that they were open to trying it (Figure 9).

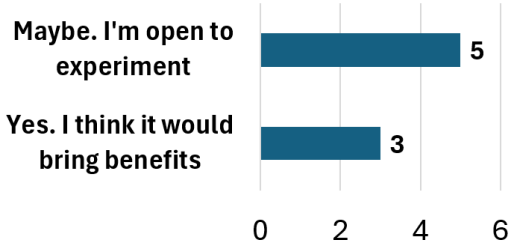

Figure 9. Do they believe that a tool including aspects of Psychology and Neuroscience would be useful?

The results indicate that motivation, emotion, and player behavior are already recognized as relevant by respondents, but are not yet consistently supported by structured frameworks or tools during early ideation.

6 Discussion

The results of this study indicate that brainstorming in game design should be understood not merely as an informal moment of idea generation, but as a situated process in which creativity, collaboration, cognition, and player-centered reasoning intersect. Although the sample is small and exploratory, the findings reveal patterns that are theoretically relevant and practically meaningful. In particular, they suggest that the main challenge is not the absence of tools, but the difficulty of aligning tools, collaborative dynamics, and design intentions in a way that supports structured ideation.

6.1 Brainstorming in Game Design as a Still Weakly Structured Practice

One of the clearest patterns in the data is the heterogeneity of tools, methods, and routines used in brainstorming sessions. Participants reported project management platforms, collaborative whiteboards, analog supports, presentations, prototyping practices, and more specialized techniques. This diversity is not problematic in itself, since creative work often benefits from flexible and context-sensitive approaches [Brown, 2009; Fullerton, 2014]. However, the responses also indicate that practitioners face recurring uncertainty about when to use a specific tool and how to organize ideation activities effectively.

This point is important because it suggests that brainstorming in game development often remains only partially structured. In design research, early concept development is commonly described as a stage of ambiguity and instability, in which designers must generate, reinterpret, and progressively organize ideas under incomplete information [Cross, 2006; Dorst, 2006]. The present findings are consistent with this view. The difficulty reported by participants does not appear to concern idea generation alone, but the management of multiple dimensions at once, including collaboration, documentation, concept articulation, and communication within the team.

This interpretation is reinforced by the fact that participants did not converge on a single specialized ideation method. Instead, they mobilized a mix of generic productivity tools, visual collaboration platforms, analog materials, and occasional design-specific techniques. This suggests that brainstorming may often rely on opportunistic combinations of available supports rather than on consolidated practices explicitly tailored to the demands of game ideation. In exploratory terms, the findings therefore point to a scenario in which brainstorming is recognized as important, but still conducted through fragmented or only partially formalized arrangements.

These results suggest that the problem faced by practitioners is not simply how to generate more ideas, but how to structure ideation so that creative, collaborative, and experiential considerations can be connected more coherently during early design.

6.2 Tools as Cognitive and Collaborative Supports

Another relevant contribution of the findings concerns the role played by tools in the ideation process. The responses indicate that participants value tools not only for organizational convenience, but also for what they enable cognitively and socially. Idea organization, real-time collaboration, creativity stimulation, and the possibility of making thoughts visible to others emerged as recurrent benefits. This is consistent with perspectives from distributed and extended cognition, which argue that reasoning can be supported by interaction with external representations and material artifacts [Hutchins, 1995; Clark and Chalmers, 1998].

From this perspective, whiteboards, collaborative platforms, sketches, notes, and prototypes do more than store information. They help reduce memory demands, externalize partially formed ideas, and support comparison, recombination, and collective interpretation. This is particularly relevant in brainstorming, where participants often need to manipulate several unstable concepts at once. Studies on cognitive load and group creativity suggest that ideation can be hindered when people must simultaneously remember, evaluate, communicate, and coordinate emerging alternatives without adequate external support [Sweller, 1988; Paulus and Nijstad, 2019]. The survey results align with this interpretation by showing that tools are appreciated when they facilitate organization and flow, and criticized when they introduce friction, complexity, or difficulty of use.

The coexistence of analog and digital methods is also

meaningful in this regard. Rather than indicating a transition from older to newer practices, the data suggest complementarity. Digital tools appear to be associated with persistence, distributed participation, and shared editing, while analog resources remain valuable for immediacy, low friction, and fluid face-to-face interaction. This pattern reinforces the idea that tools are selected not only because of their features, but because of the type of cognitive and collaborative support they offer in a given context.

Thus, the findings support the interpretation that brainstorming tools in game design function as part of a broader cognitive ecology. Their relevance lies less in technological sophistication alone and more in their capacity to support creative reasoning, shared understanding, and continuity between idea generation and concept refinement.

6.3 Motivation and Emotion as Explicit Design Dimensions

The results concerning Psychology and Neuroscience are particularly significant because they reveal a strong perceived relevance of motivational and emotional aspects in game design. All participants considered knowledge about human behavior to be either important or fundamental, and all reported considering players' emotions either always or most of the time in their design decisions. In addition, understanding player motivation was rated as fundamental by most respondents. These findings are consistent with research showing that player experience is shaped not only by formal systems, but also by how players interpret goals, rewards, uncertainty, challenge, and meaning throughout play [Ryan *et al*., 2006; Przybylski *et al*., 2010; Isbister, 2016].

These results should therefore be interpreted with conceptual caution. Because the questionnaire used broad professional terms rather than formal definitions from specific theoretical models, the findings indicate that participants recognize the practical relevance of behavior, motivation, and emotion, but do not demonstrate that they interpret or apply these concepts with the same theoretical nuance discussed in the literature.

At the same time, the responses reveal an important contrast: while psychological aspects are valued, the explicit use of frameworks to address them remains limited. Only a minority of respondents reported prior use of a formal framework related to these dimensions, while most expressed interest but no concrete experience. This suggests that motivation and emotion may already be present in design reasoning, but often in an intuitive, implicit, or weakly structured manner. In other words, the issue is not a lack of awareness of their importance, but a lack of operational supports that help teams articulate these dimensions consistently during brainstorming.

This gap is highly relevant for game design. Frameworks such as MDA and the Elemental Tetrad help designers reason about relationships between systems and experience [Hunicke *et al*., 2004; Schell, 2019], while emotional and motivational models help define what kinds of experiences may be meaningful to players [Plutchik, 1980; Ekman *et al*., 1999; Yee, 2006, 2016]. However, knowing that such models exist does not necessarily mean that they are being translated into everyday ideation practices. The present findings suggest that player-centered reasoning is recognized as valuable, but not yet fully integrated into the practical structure of brainstorming.

This pattern reinforces the interpretation that one of the main challenges in early game ideation is not simply acknowledging the relevance of player motivation and emotion, but making these dimensions explicit and actionable within the collaborative process of concept formation.

6.4 Implications for Brainstorming Tools in Game Design

The findings of this study also have practical implications for the design of future brainstorming supports. Participants' responses suggest that useful tools should be easy to use, collaborative, flexible, and capable of combining visual and textual information without imposing excessive operational burden. These characteristics point to an important design principle: brainstorming tools should support thought, not compete with it. In ideation contexts, a tool that is feature-rich but difficult to appropriate may be less useful than a simpler artifact that better supports the rhythm of creative exploration.

In addition, the strong recognition of the relevance of player motivation, emotion, and behavior suggests that there is room for tools capable of helping designers integrate these dimensions more explicitly into early concept development. Rather than functioning only as repositories of ideas or task boards, such tools could serve as structured prompts that help connect design elements, intended player responses, and motivational orientations. This interpretation is aligned with research on card-based and theory-informed design tools, which shows that artifacts can help translate abstract concepts into manipulable prompts for ideation and discussion [Inie and Dalsgaard, 2020; Ho and Tomitsch, 2019; Baharom *et al*., 2014; Ricchiuti, 2022].

A possible operationalization of this idea would be to transform theoretical constructs into question-based prompts. For example, if a team defines anticipation as an intended emotional response, based on an emotion model such as Plutchik's [Plutchik, 1980], and relates it to achievement or progression-oriented motivations [Yee, 2006, 2016], a brainstorming support could ask: which mechanics, feedback loops, pacing strategies, or uncertainty structures may sustain anticipation while still communicating progress to the player? In this case, emotional theory would help define the intended affective target, motivational theory would help clarify why this experience may matter to the player, and game design frameworks such as MDA or the Elemental Tetrad would help identify which design elements can be manipulated during ideation [Hunicke *et al*., 2004; Schell, 2019].

Importantly, the survey does not by itself demonstrate that a particular type of tool will solve the difficulties identified. However, it does provide exploratory evidence that practitioners are receptive to more structured supports and that current practices may not fully address the challenge of integrating player-centered dimensions into brainstorming. In this sense, the study contributes less by validating a solution than by clarifying design requirements and evidencing a practical opportunity for future interventions.

The discussion suggests that brainstorming in game design can benefit from supports that combine cognitive scaffolding, collaborative flexibility, and explicit attention to player experience. This does not imply replacing existing practices with a single standardized method, but rather developing tools and approaches that help designers articulate creativity, structure, and player-centered reasoning more coherently during early concept formation.

Overall, this study contributes to the understanding of brainstorming in game design by showing that ideation practices are shaped by more than tool preference alone. They involve the management of ambiguity, the coordination of distributed cognition, the negotiation of collaboration, and the attempt to anticipate player experience from the earliest stages of design. In this sense, the findings help move the discussion beyond a descriptive inventory of tools and toward a more analytical understanding of brainstorming as a structured design problem in its own right.

6.5 Study Limitations

This study has limitations that should be taken into account when interpreting its findings. First, the number of respondents was small (8 participants), which limits the scope of the conclusions and does not allow statistical generalization. This limitation directly affects the external validity of the study, since brainstorming practices may vary according to studio size, production pipeline, design culture, regional context, and professional specialization. Thus, the findings should be understood as exploratory evidence derived from a small but relevant group of participants, rather than as a representative picture of the game industry as a whole [Creswell and Creswell, 2017; Trivisios, 1987]. Future studies should expand the sample size and include participants from more diverse organizational and cultural contexts in order to strengthen the robustness and external validity of the findings.

Second, the participants were all situated in the Brazilian context, which may have influenced the perspectives captured in the study. Although this does not reduce the analytical value of the responses, it does mean that the results may reflect local professional cultures, resource constraints, and organizational practices that differ from those found in other countries or regions. For this reason, caution is needed when extrapolating the findings to broader international contexts.

Another limitation concerns participant recruitment. The data collection period was limited to two days due to operational constraints, including the available research window, the preparation of the study materials, and the submission timeline. Although this decision allowed the evaluation to be completed within the planned study schedule, it may have restricted recruitment and contributed to the small sample size.

A related limitation concerns recruitment transparency. Because the questionnaire was distributed through open online channels, the exact number of communities contacted and the number of individuals who viewed the invitation were not systematically recorded, which prevented the calculation of an overall response rate. This limits the replicability of the recruitment process and makes it more difficult to assess potential self-selection bias. To mitigate these limitations in future replications, we plan to extend the recruitment and data collection period, begin recruitment earlier, systematically register contacted communities and estimated invitation reach, send periodic reminders, and define a minimum recruitment goal before closing data collection.

A third limitation concerns the heterogeneity of the sample itself. The questionnaire included respondents from different roles, levels of experience, and organizational settings, which enriched the exploratory scope of the study, but also introduced variation that could not be deeply controlled or compared due to the reduced number of participants. As a result, the study does not support stronger claims about how particular roles, such as programmers, artists, or game designers, differ systematically in their brainstorming practices.

Another limitation concerns the questionnaire validation process. Although the instrument was reviewed by two Game Design specialists before data collection, no pilot study was conducted with participants from the target audience. Future studies should include a pilot test to assess question interpretation, completion time, and potential ambiguities before full application.

In addition, the study relied on self-reported perceptions. This means that the results reflect how participants describe their own practices, difficulties, and values, but do not directly observe brainstorming sessions in real time. Consequently, the findings provide access to perceived practices rather than to behavioral evidence of how ideation unfolds in actual design meetings. This distinction is important because reported preferences and actual use may not always coincide.

Finally, the qualitative analysis of the open-ended responses was thematic and exploratory, rather than based on a more formalized coding procedure with multiple rounds of independent validation. This does not invalidate the interpretive value of the responses, but it does delimit the level of analytical precision that can be claimed. In this sense, the contribution of the study lies in identifying tendencies, tensions, and opportunities for further investigation, rather than in establishing definitive explanatory models.

6.6 Implications and Future Work

Despite these limitations, the study offers relevant implications for both research and practice. From a practical perspective, the findings suggest that brainstorming in game design may benefit from tools that better support idea organization, collaborative visibility, and low-friction interaction, while also helping teams reflect more explicitly on player-centered dimensions such as motivation, emotion, and behavior. The survey indicates that practitioners already recognize the relevance of these aspects, even when they do not yet use formal frameworks to integrate them systematically into ideation.

From a research perspective, the study contributes by clarifying a design space for future interventions. Rather than pointing to a single missing tool, the findings suggest a broader opportunity for theory-informed supports capable of connecting game design decisions to intended player experience during early concept formation. In this sense, the

questionnaire functions as a diagnostic stage that helps identify requirements for more structured brainstorming artifacts and methods.

These implications are directly connected to the related works discussed in Section 3. Methods such as ABCDE and CaSEJ show that structured supports can help organize creativity and brainstorming in specific game design contexts [Possamai *et al*., 2021; Oliveira *et al*., 2023], while the cookbook method for Persuasive Game Design illustrates how theoretical and methodological knowledge can be translated into flexible design guidance [Siriaraya *et al*., 2018]. Emotion-centered frameworks also reinforce the relevance of considering affective experience during pre-production and development [Baharom *et al*., 2014; Croissant *et al*., 2023]. However, the present findings suggest that practitioners may still lack supports that combine these contributions with explicit attention to motivation, emotion, and player behavior during early brainstorming.

Building on this connection between the survey findings and previous design-support approaches, future studies may expand this work in at least three directions. First, it would be valuable to broaden the sample in order to include participants from different countries, production contexts, and areas of specialization, allowing comparisons across studio cultures and professional roles. Second, observational studies could complement questionnaire data by examining how brainstorming practices actually unfold in real design sessions, making it possible to compare reported and enacted behaviors. Third, future research may investigate the design and evaluation of interdisciplinary brainstorming tools that explicitly integrate concepts from Game Design, Psychology, and Neuroscience, testing whether such supports improve idea organization, collaborative alignment, and player-centered reasoning during ideation.

These directions are especially relevant because the present study does not claim that current difficulties can be solved by any single framework or tool. Instead, it identifies a practical and conceptual opportunity for future work: developing and evaluating supports that help designers connect creativity, collaboration, and player experience more explicitly during the earliest stages of game conception.

Future work may also examine the growing use of Large Language Models (LLMs) in brainstorming and early game ideation. LLM-based tools may support idea generation, variation, reframing, and the articulation of design alternatives, but they should not be treated as neutral replacements for structured creative methods or human collaboration. Recent evidence on LLMs as creativity support tools suggests that they may increase the number and detail of generated ideas while also reducing semantic diversity across users and weakening the perceived responsibility for the ideas produced [Anderson *et al*., 2024]. In the context of game design, this raises questions about over-reliance, homogenization of concepts, reduced designer agency, and the need to combine AI-based support with methods that preserve critical reflection, diversity, and player-centered reasoning.

7 Final Considerations

This study investigated the tools and methods used by game designers in brainstorming sessions, with the objective of understanding preferences, difficulties, and perceptions regarding the integration of concepts from Psychology and Neuroscience into the creative process. The results showed that brainstorming practices are supported by a diverse set of artifacts, including project organization platforms, visual collaboration tools, analog resources, and early prototyping strategies. More importantly, the findings indicate that these tools are valued not only for operational reasons, but also for the cognitive and collaborative functions they perform during ideation.

The study also revealed that participants recognize the practical importance of considering player motivation, emotion, and behavior during game design. However, this recognition does not necessarily translate into the systematic use of formal frameworks or structured methods during brainstorming. This contrast between perceived relevance and limited procedural integration is one of the main contributions of the study, as it helps clarify that the challenge in early ideation is not only generating ideas, but organizing them in ways that connect design decisions to intended player experience.

From an academic perspective, the article contributes to the discussion of brainstorming in Game Design by treating it as more than a generic creativity technique. The findings suggest that brainstorming should be understood as a design activity shaped by ambiguity, distributed cognition, collaborative negotiation, and attempts to anticipate player-centered outcomes from the earliest stages of conception. From a practical perspective, the study provides initial evidence that may inform the development of more structured brainstorming supports capable of articulating game systems, emotional goals, and motivational orientations.

Although exploratory in scope, the study offers a useful empirical basis for future investigations and interventions. By mapping current practices and identifying recurring tensions, it helps bridge theory and practice in the study of early game design. In this sense, its contribution lies not only in describing which tools practitioners use, but also in showing why these practices matter for the broader challenge of creating more coherent, reflective, and player-centered ideation processes in digital game development.

Declarations

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Authors' Contributions

Diego Angellus Duarte D'Andrea (DADD) contributed to the study execution, data analysis, writing of the majority of the manuscript, and the creation of the figures and tables. Tadeu Moreira de Classe (TMC) restructured the overall organization of the extended version, contributed additional content, the methodological view of the manuscript, and validated the writing. Sean Wolfgand Matsui Siqueir (SWMS) reviewed the article. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The spreadsheet analysed during the current study is available in `https://doi.org/10.6084/m9.figshare.32024229`.

Further relevant information

This article used the tool Grammarly to correct the text. Besides that, the article used ChatGPT 4o to assist with some translations from Portuguese to English.

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