

Piecing the puzzle together: Towards improving digital tools for board game design

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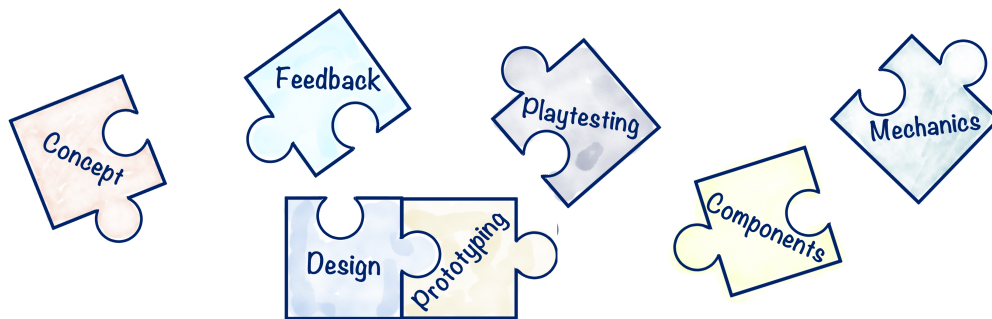


Figure 1: Original illustration visualizing the process of this research: Each puzzle piece represents an integral part of the board game creation process, and the aim of this work is to discover the way the pieces connect with each other.

Abstract

This paper explores the challenges and requirements of board game designers in the digital era. While digital tools have become increasingly prevalent—especially for prototyping and playtesting—they often fail to fully support early-stage design and lack the social and tactile elements crucial to board games. Building on a previous survey study, this research delves deeper into these challenges employing a quantitative survey followed by qualitative interviews with 9 individual board game designers. The interviews followed a semi-structured format, covering key discussion points such as the design process, time and cost factors, and digital tools. The findings reveal key limitations in existing digital tools, particularly in facilitating ideation and replicating the nuanced interactions of physical playtesting. The paper also discusses the potential of emerging technologies like AI and XR to further revolutionize board game design by addressing current limitations and enhancing the creative process. Based on these insights, the study outlines a set

of specifications to be integrated in digital tools, aiming to bridge the gap between digital innovation and the hands-on nature of traditional board game development.

CCS Concepts

• **Human-centered computing** → **User studies**.

Keywords

board game design, playtesting, digital tools for board game creation, user study

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1 Introduction

In a set of puzzle pieces, not every combination fits. You must find the right connections, assembling them step by step. And suddenly, the full picture comes together.

Fostering collaboration, creativity and critical thinking, board games have held a special place in social and educational contexts for a long time. Over the last years, the board game industry has



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been experiencing an upturn, with game designers pushing the boundaries of creativity and functionality. Especially due to the COVID-19 pandemic, there has been a real need for the board game community to find effective ways to operate remotely through digital tools and platforms. However, the tools available to support the design and development of board games come with their set of shortcomings, ultimately falling behind the industry's needs and innovative spirit.

In this study, we build upon our previous research, which explored the challenges and requirements faced by board game creators through a comprehensive questionnaire survey [10], aiming to answer the following research question: **What are the key functionalities and specifications that should be integrated in the design of next-generation digital tools to effectively support the creative processes of board game designers?**

The initial investigation [10] provided valuable insights into the difficulties encountered when designing board games for the physical world. Having identified the core limitations of existing design tools, we now seek to broaden the scope of our research by delving deeper into the creative processes and expectations of designers regarding the next-generation of digital tools, slowly piecing the puzzle together (Figure 1). To achieve this, we employ a mix of quantitative and qualitative research methods, aiming to identify and categorize a set of essential functionalities and specifications that address the needs of board game creators. We conducted a series of interviews accompanied by pre-interview questionnaires with 9 board game creators, representing diverse backgrounds, experience levels, and areas of expertise. The interviews were carried out in a semi-structured format, covering but not limited to the following discussion points: (a) **design process and its specific steps**, (b) **time and cost** and (c) **digital tools**. The findings from this study will serve as the foundation for the development of future platforms, tailored to support and enhance the creative workflow of designers.

A structured overview of the paper is as follows: Section 2 provides a concise summary of the research supporting the rationale behind organizing the study. Section 3 outlines the methodology employed in the user study, followed by Section 4, which presents the analysis of the interview data and the key findings. Finally, Section 5 offers a discussion of the results, while Section 6 concludes the paper.

2 Background & Motivation

In this section, we combine the key findings of our previously conducted questionnaire survey [10] along with a literature review to provide a solid background for supporting the motivation behind organizing the present study. The following segments discuss the process and difficulties of game design, as well as the different aspects of using digital tools as a solution to these challenges.

2.1 The design process & its challenges

The design and creation of games is a multifaceted process, drawing from various different disciplines to create one engaging product. In his book "The Art of Game Design: A book of lenses", Jesse Schell [17] highlights that successful game design creates a cohesive experience, with the game serving as a medium for this purpose. Balancing game mechanics, integrating different game

aspects seamlessly into gameplay, and fostering player immersion are essential to the process [2, 11]. Effective game design involves user-centered approaches, considering player demographics, preferences, and behaviors, while iterating through testing and feedback cycles to refine the experience [9, 17, 18]. Moreover, playtesting is vital for identifying design flaws, improving accessibility, and ensuring an engaging player experience by incorporating player feedback into iterative development [3, 17].

Board Game Creation Process

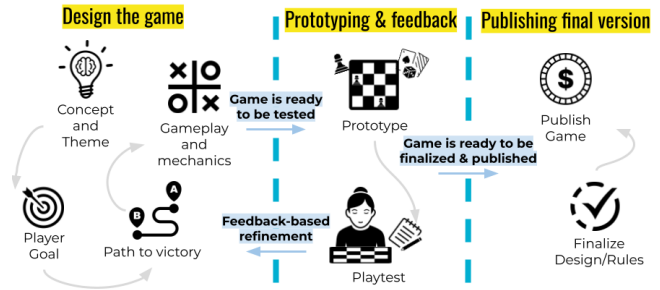


Figure 2: Original conceptual schema showing the board game creation process end-to-end. Created using free, 0-attribution icons.

Being one of the most complex and multidimensional types of games, board games come with their own set of challenges on all the aforementioned aspects. As visualized in Figure 2, designers need to consider multiple options and make conscious choices at each stage of the creative process, often struggling to find a balance between the elements that are required to build an engaging and smooth gaming experience. Requiring numerous cycles of iterations and feedback loops, the playtesting phase tends to be the most demanding and time-consuming stage of board game design. As suggested by our survey's findings [10], the process of traditional playtesting can be significantly expensive and logistically challenging, as it relies heavily on in-person participation, tangible prototypes, and securing availability of designated spaces. Moreover, evidently it is not uncommon for creators to spend anywhere from a few weeks to a few months to recruit a sufficient number of suitable playtesters who would commit to participating throughout the whole iterative process, which can often require more than 10 cycles. Albeit its complexities nonetheless, playtesting is possibly considered as the most important step of the creative process, serving as an active lab for experimenting and as it is crucial for finding design flaws, boosting accessibility, and creating truly engaging player experiences through iterative feedback [3, 17].

2.2 Digital tools & mediums

Over the past few years, digital tools have emerged in the board game community, posing as valuable assistants to the creative process. Looking into the questionnaire's results [10], it is evident that creators utilize various digital tools and platforms for maximizing efficiency in design, prototyping and playtesting tasks. The findings show that some of the most valued features of such mediums include

remote playtesting, component management, asset customization, bulk asset management, and virtual table organization.

This broad adoption of digital tools highlights their role in streamlining the game development process, particularly in playtesting, where they offer several key advantages over traditional physical methods. The survey revealed that such tools can help transform the playtesting phase into an easier, faster, more cost-effective and overall accessible process, providing ease, speed, cost-effectiveness, allowing quicker iterations and prototype alterations. Additionally, remote playtesting offers designers access to a larger community of playtesters, expanding their reach beyond local groups and fostering diverse feedback.

On the other side of the spectrum, some of the findings underscore the weaknesses of the digital playtesting mediums. Inability to capture physical interactions, as well as maintain the social aspects of tabletop gaming are core limitations, since physical and social cues such as facial expressions, body language, and natural player interactions are essential for assessing player engagement and emotional responses. In terms of usability, issues such as steep learning curves and design constraints are capable of hindering both game creation and testing. Moreover, digitally replicating physical game mechanics based on space, tactile feedback and dexterity can often be quite problematic, sabotaging the gameplay experience. Last but not least, finding suitable playtesters for different types of games also presents a major challenge.

It is important to note that the board game community has been quite vocal through various sources like articles, forums, and blogs, providing feedback that supports the outcomes of the survey [1, 8, 12, 15].

Building on the broader context of board game design and the limitations of current digital tools discussed in this section, this study is ultimately driven by the need to identify the essential functionalities and specifications for ideal design tools. While existing literature offered a valuable foundation, it was not able to provide the depth of understanding we are searching for on its own. Furthermore, our previous questionnaire survey, while informative, proved insufficient for capturing the nuanced perspectives of designers. To gain a richer, qualitative understanding of their needs and expectations, we decided to pursue open-ended discussions through interviews with individual creators.

3 User study

In this section we present the methodology and process of our user study. The study employs a mixed methods approach, involving a quantitative pre-interview survey and a qualitative interview, to gather insight regarding the user requirements and their corresponding set of specifications for digital tools supporting the board game creation process. A total of 9 board game creators of different backgrounds and levels of experience participated in the study.

3.1 Pre-interview questionnaire

Since this study was based on the previously conducted survey [10], expanding on gathered data through open-ended discussions, it was essential for all participants to have completed the survey questionnaire before the interview. The questionnaire comprised

of the following sections: (a) **Participants profile:** Questions regarding participants' preferences, frequency of play, the number and type of games designed, and the estimated time from concept to playtesting, (b) **Digital mediums and board games:** Questions focusing on participants' experience with digital board games and the use of existing digital design tools, (c) **Digital tools for creators:** Questions for gathering detailed feedback on existing tools, including ratings, advantages, and drawbacks compared to physical playtesting, and (d) **Playtesting with users:** Questions covering aspects such as cost, time, iteration cycles, recruitment challenges, and player feedback.

The full version of the survey questionnaire can be found [here](#).

3.2 Interviews

The insights gathered from the questionnaire survey provided us with a solid foundation of creators' different opinions and experiences with physical and digital board game creation. To expand on this data, we designed an interview with a semi-structured format so as to engage in more open-ended discussions with designers and understand their unique perspectives. The interview focused on, but was not limited to, the following discussion points: (a) **The design process and the specific steps followed by each creator**, (b) **The time spent and cost of different aspects of the design process** and (c) **The experiences gained by the use of the digital tools already available**.

The main goal of the interviews was to encourage participants to share additional insights into their creative processes and unmet needs, allowing us to explore areas beyond the scope of the original survey. However, due to the latter's limiting structure, we decided that there was significant value in having participants elaborate on some of their most interesting and noteworthy responses, providing further explanations, particularly regarding the rationale behind answers to closed-ended questions.

The full version of the interview questionnaire can be found [here](#).

3.3 Participants & Process

Initially, we started the process by approaching the designers who had participated in the original survey via email. Additionally, we posted open calls for participation on different platforms such as board game design groups on Facebook and appropriately themed forums on BoardGameGeek. Eventually, 9 creators responded to our approaches, each of whom were asked to choose from a set of available time slots to schedule an online interview. Before carrying out the interviews, we made sure that all interviewees had answered the pre-interview questionnaire- same as the one distributed during the previous study- so as to gather all the basic information regarding the participants' background and opinions. Moreover, this gave us the opportunity to analyze the answers beforehand in search of interesting remarks hidden within the answers, in order to be discussed during the interviews. The interviews were carried out via Microsoft Teams, after the participant had filled in and signed the provided participation consent form.

4 Analysis and Results

After all sessions with participants were completed, we proceeded with the analysis of the collected data. Starting with the quantitative data, we analyzed participants' responses to the pre-interview questionnaire, to gather insights regarding their profile as players and designers, expertise, experience with digital tools and playtesting. When needed, we include figures for the presentation of the questionnaire results.

When it comes to the qualitative data, all interviews were transcribed and an analysis was performed on the transcripts and notes kept by the interviewers during the interviews. The participants' responses were analyzed in relation to the discussion points of the interview questionnaire and grouped accordingly with tables to ensure alignment with the core themes of the study. Our goal was to ultimately provide a comprehensive understanding of the data, as well as possibly identify recurring patterns across the participants' responses. More specifically, regarding the functional specifications, this study employs a combination of qualitative analysis and research synthesis [16], meaning that the key findings are integrated with research-driven insights and industry trends to produce a unique set of specifications.

The results of the study are presented in the following sections, organized around the key themes discussed.

4.1 Participants' profile

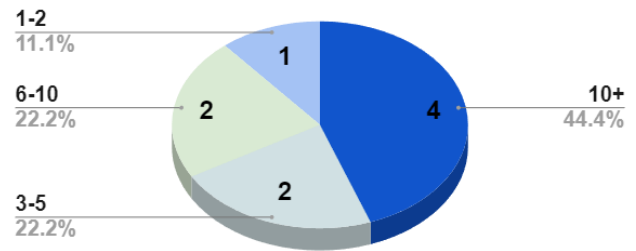
As mentioned in the previous section, 9 people participated in the study. As players, 44.4% (4) participants reported playing board games more than 10 times a month, 22.2% (2) between 6 and 10 times, 22.2% (2) between 3 and 5 and the remaining 11.1% (1) reported playing 1-2 times (Figure 3a) The participants' board game preferences are presented in Figure 3b. The answers regarding the preferred types were not mutually exclusive, so participants had the option to choose multiple types of games.

Regarding the participants' level of expertise as game designers, out of the 9 participants, 33.3% (3) have created over 50 games, 11.1% (1) fluctuate between 20 and 50 games, 22.2% (2) between 10 and 20 games, 11.1% (1) between 5 and 10, while 22.2% (2) participants stated that they have created less than 5 games, as shown in Figure 4a. The types of games designed by people are presented in Figure 4a. As with the most popular game types in play, answers regarding the types of games designed were not mutually exclusive.

4.2 Design process

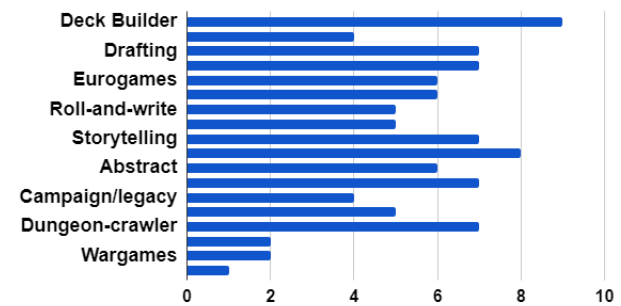
The interviews started with the section regarding the participants' unique approaches in conceptualizing and designing their board games. Table 1 presents an overview of each participant's design approach and the concrete steps of their design process. In general, we can see that designers tend to follow a variety of approaches, with no single method universally applicable. The various starting points of the creative process might include a core concept, an overarching theme, a specific game mechanic (sometimes driven by client requests), a particular component, or even just a catchy title. More specifically, according to Table 1, starting with a core concept seems to be the most popular practice among the participants of this study, since 66.6% (6) participants stated it as their first step (P1, P3, P5, P6, P8, P9).

How many times a month do you play boardgames?



(a) Participants' frequency of monthly play

What types of boardgames do you play?



(b) Types of games played by participants

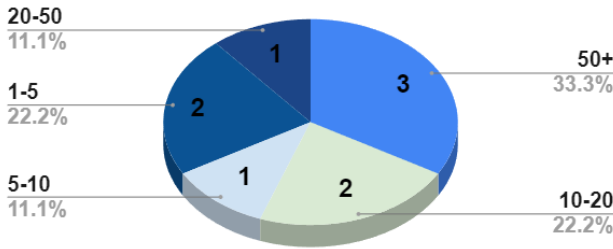
Figure 3: Information about participants' profile as players, derived from pre-interview survey

Additionally, one participant argued that it is not uncommon for inspiration to strike from unexpected sources such as jokes, random conversations, puns or events from the designer's daily life. According to some participants, it is a common practice to start small when designing a game, slowly developing individual elements, and then gradually building upon them. The order of these steps, and the interplay between concept, theme, and mechanics, can vary depending on the specific game and the designer's individual style. Reverse engineering at different levels was also discussed as a common practice, as it allows creators to iteratively adjust mechanics and dynamics, aiming towards a well-aligned and effective game experience. As one participant commented, *"Balancing game complexity with simplicity is the hardest challenge."*

4.3 Time and cost

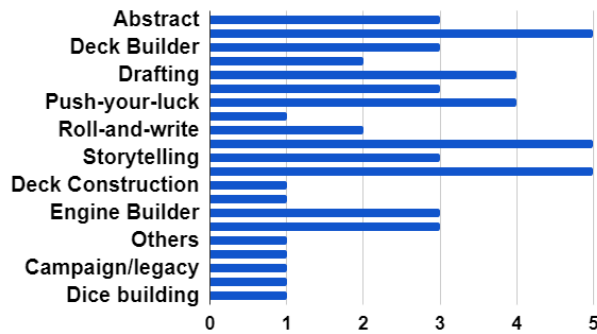
The next part of the interviews involved conversations around the aspects of board game creation that cost the most and last the longest. Firstly, before discussing the information revealed through the interviews, it is interesting to note the range of time spent from the conception of a board game idea until organising its first playtesting session, as submitted in the questionnaires. Participants had the choice to select multiple answers. According to Figure 5, 33.3% (3) participants reported that the process would require a few weeks. Another 33.3% (3) reported a duration of less than a week. The remaining 33.3% (3) of the user pool was equally divided

How many boardgames have you designed/created?



(a) Amount of games designed by participants

What types of boardgames have you designed/created?



(b) Types of games designed by participants

Figure 4: Information about participants profile as designers, derived from pre-interview survey

among the answers “More than a year”, “A few months” and “One or two months”. There were also some responses stating that the duration depends on varying factors. More specifically, 33.3% (3) people stated that the complexity of the game plays an important role, while 11.1% (1) attributed these variations to their personal time and effort.

How much time is there usually between the conception of a boardgame idea and its first playtesting session?

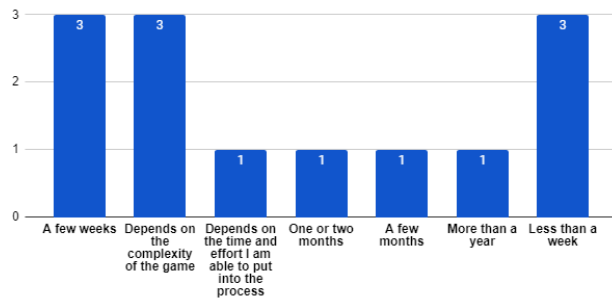


Figure 5: Duration between conception of a board game idea and its first playtesting session

Table 1: Overview of participants’ design approaches and the concrete steps of their design process, derived from the interview analysis

P	Design Process	Steps
P1	Starts with theme or mechanism, iterates based on playtesting.	Concept → Physical prototype → Playtesting → Adjustments.
P2	Starts with a core mechanic and builds upon it.	Prototype → Playtesting → Refinement → Convention presentation.
P3	Game starts from a theme, mechanic, or component.	Concept → Prototype (physical/digital) → Playtesting.
P4	Starts with sketches, then digitizes for production.	Sketch → Google Slides → Digital design → Playtesting.
P5	Three approaches: mechanic-first, theme-first, or publisher-oriented.	Concept → TTS playtests → Iteration.
P6	Starts with mechanics, refines through dummy players and playtests.	Concept → Draft rules → Dummy playtesting → Final refinement.
P7	Begins with a mechanic, builds the theme around it.	Balance calculations → Digital/physical prototype → Playtesting.
P8	Two paths: self-driven or publisher-driven design.	Concept → Digital or physical prototype → Iterative testing.
P9	Depends on whether designing for clients or personal projects.	Concept document → Iterations → Playtesting → Refinement.

Moving on to the interviews, according to the responses presented in Table 2, Board game designers consistently cited playtesting as the most time-consuming and expensive aspect of game development. Bigger costs are primarily associated with physical prototyping, as well as the recruitment and compensation of playtesters. Interestingly, one participant (P8) stated that while digital tools and remote playtesting can help reduce the costs, using them can be extremely time-consuming, mentioning their frustration of unoptimized existing software. Other time-related challenges such as slower digital playtesting or the time investment required to learn and use the tools effectively were also mentioned.

4.3.1 Playtesting. "Finding playtesters is harder than making a prototype." -P2

Taking into account that playtesting was unanimously considered by all participants to be the most challenging stage in terms of cost and time, we thought that delving deeper into the statistics, as well as the discussions spawned during the interviews would be quite insightful. Firstly, looking roughly into the data produced

Table 2: Concise descriptions of most costly and time-consuming aspects of board game creation according to participants, derived from the interview analysis

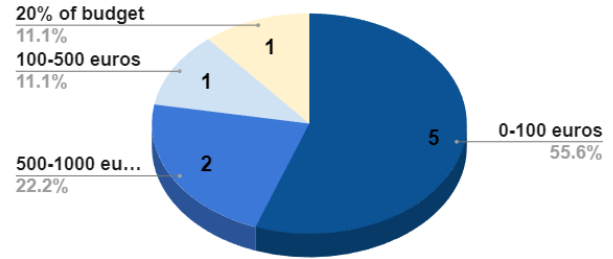
P	Time and Cost
P1	1-6 months, varies by complexity. Costs mostly come from physical components.
P2	Playtesting takes the most time; physical prototypes cost money.
P3	Physical prototyping is expensive; digital playtests are slower.
P4	Game design takes over a year; recruitment for playtests is the hardest part.
P5	Playtesting and refining take time; online playtesting reduces physical costs.
P6	Prototypes cost €100-150 each; playtesting is the largest expense.
P7	Balancing takes time; physical prototyping increases costs.
P8	900+ hours in TTS; digital tools reduce costs but take time.
P9	Playtester compensation is expensive; remote playtesting helps.

by the in the pre-interview survey, we notice that a big portion (55.6%, 5 people) of the participants spend between 0-100 euros for playtesting, 33.3% (2) spend over 100 and 11.1% (1) estimated to be spending approximately 20% of their full budget. In regards to the recruitment of playtesters, the majority of participants (77.8%, 7 people) reported requiring a few days, while the number of testes varies, with 44.4% (4) stating that they usually find 1-10 people, and the remaining 55.5% (5) over 15. Additionally, regarding the number of feedback cycles comprising the playtesting process, the vast majority of participants (77.8%, 7) reported requiring more than 10, while the remaining 22.2% (2) stated they need between 1 and 6 cycles. A detailed presentation of these statistics can be found in Figures 6 and 7.

Moving on to the interview insights, it was a common belief that designers can begin playtesting their games once the core gameplay loop feels satisfactory and no more potential flaws are identified. It is at this stage that getting the perspective of external people is crucial. Some participants discussed the advantages of blind playtesting where players experience the game without prior knowledge or input from the designer. They mentioned that insights from this type of evaluation can prove particularly valuable for revealing non prominent issues. Testing with inexperienced players was referred to as another useful approach for refining and simplifying a game, since it can easily uncover areas of confusion and usability issues.

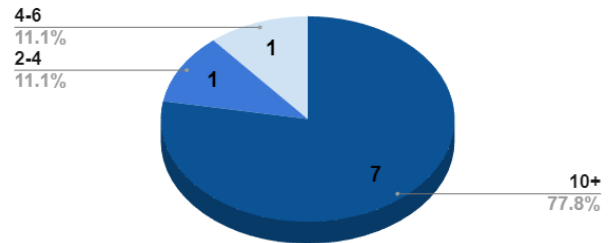
One suggestion for overcoming recruitment challenges emerged through conversation. The participant argued for the ability of digital tools to facilitate access to different types of playtesters, providing player profiles with both self-reported and automatically

What is the approximate cost of the playtesting process?



(a) Approximate cost of playtesting

Approximately how many repetitions of tests and changes are usually needed during playtesting?



(b) Number of playtesting repetitions/cycles usually required

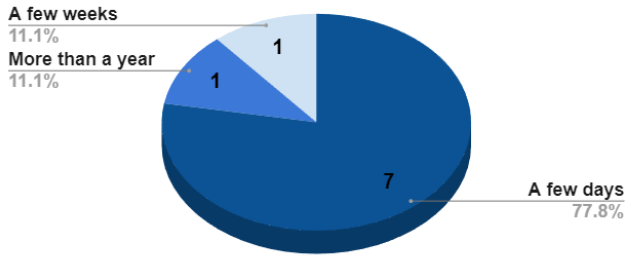
Figure 6: Time and cost statistics for the playtesting process, derived from pre-interview survey

generated experience metrics, thus enabling designers to select appropriate playtesters. The value of this proposition can be mirrored to similar aspects of a typical HCI evaluation, distinguishing between expert and user playtesters is beneficial, allowing designers to target specific feedback.

4.4 Digital tools and platforms

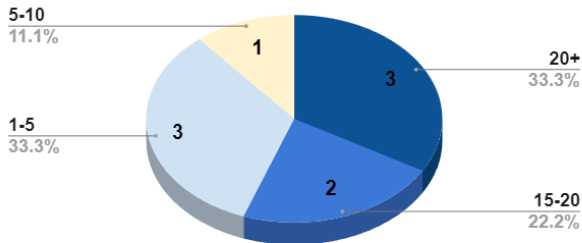
When it comes to the role digital tools and platforms have in the creation of board games, participants expressed varied views. According to the in the pre-interview survey, 66.6% (6) participants stated that they have used digital tools while designing games in the past. For those participants, the responses for the most important features of a digital board game creation tool are presented in Figure 8. As shown in the figure, the ability to playtest games with people remotely was the most popular without opposition, with the creation and customization of assets and components earning the second place with 5 votes. Mass asset creation and organization, as well as placement and organization of assets on a virtual table came third, each earning the vote of 4 participants respectively. Moreover, another feature that is considered important by half of the participants, is the ability of the platform to facilitate the formation and maintenance of a community of players and creators for feedback and playtesting. Publishing board games digitally, defining rules and easy scripting earned the vote of one participant each.

How much time does the recruitment process usually take?



(a) Duration of the recruitment process

Approximately how many users do you usually find to playtest your game?



(b) Approximate number of required playtesters

Figure 7: Time and participation statistics for the recruitment process, derived from pre-interview survey

What are, according to you, the most important features a digital tool for boardgame creation should have?

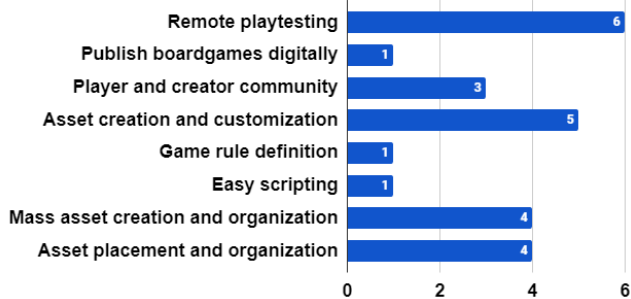


Figure 8: Participants’ answers for most important features of digital tools for board game creation, derived from pre-interview survey

Table 3 presents some concise descriptions of what participants discussed for the role digital tools and platforms play in the design process at this section of the interviews. We can see that 3 participants reported using tools at the stage of design and early prototyping, with 2 being more specific in their preferences, mentioning the use of tools like Excel for game balancing and AI assistance for asset generation (P7, P9).

Table 3: Concise descriptions of the role of digital tools in board game creation, derived from the interview analysis

P	Role of Digital Tools
P1	Useful for early playtesting, replacing physical prototypes.
P2	Not used much. Prefers physical playtesting.
P3	Tabletop Simulator used for early tests, but playtesting takes twice as long digitally.
P4	Used for early design but prefers physical playtesting.
P5	Essential for remote playtesting and modifications.
P6	Helps with testing before making expensive physical copies.
P7	Excel for balancing, AI for generating assets.
P8	Critical for remote design but still requires physical testing.
P9	Excel, Trello, AI-assisted art, collaborative tools.

4.4.1 *Playtesting.* As with the design section of the interviews, this section was inevitably mainly focused on the playtesting stage as well, since, according to Table 3, the majority of participants discussed digital tools in the context of playtesting their games. This realization was not surprising, considering that remote playtesting was deemed as the most important feature among all participants in the pre-interview questionnaire survey (Figure 8). While some found digital tools, like Tabletop Simulator or Tabletopia, useful for early playtesting and reducing the need for physical prototypes (P1, P3, P6), others seemed to prefer physical playtesting (P2, P4). Several participants highlighted the importance of digital tools for remote collaboration and playtesting (P5, P8, P9), particularly for modifications and reaching a wider playtesting audience.

Despite the benefits of digital tools, several participants emphasized the continued need for physical playtesting (P2, P4, P8), even when remote design and prototyping was involved (P8). P3 also noted that digital playtesting could be significantly slower and less intuitive than its physical counterpart (Table 2 & 3), sometimes lasting twice as long and adding complexity to the overall process, due to its “clunkier” and “slower” controls. More specifically, “The way the people physically engage is different, [digital playtesting is] like having your dominant hand tied behind your back”, P3 commented.

4.4.2 *Suggested Features.* Due to the nature and goal of this study, a significant portion of the interviews focused on the features participants consider important for a digital board game creation tool. These suggestions are categorized as important or additional features, mainly focusing around the following themes: playtesting enhancements, asset management, automation, and collaboration. Looking into Table 4 we can see that a lot of participants put emphasis on features aiming to improve the playtesting experience

(P2, P6, P7). Specifically, they suggested better feedback integration to streamline the collection and analysis of player feedback. Additionally, enhancing tools with the ability to simulate game mechanics was proposed as a way to allow designers to model and predict game behavior before moving forward with extensive physical prototyping (P4). These suggestions directly address the challenges and inefficiencies associated with traditional playtesting, reinforcing the need for a more streamlined and effective approach, as discussed in the earlier sections.

Table 4: Important and additional feature suggestions made by the participants of the study for their ideal digital creation tool, derived from the interview analysis

P	Important Features	Additional Features
P1	Managing card size, better playtest tools.	Dropdown for assets like cubes, pawns, tokens.
P2	Templates for cards, dexterity-based mechanics.	Better ways to integrate playtesting feedback.
P3	Stability, component management, better abstraction.	More automation to speed up digital playtesting.
P4	Quick card creation, ability to simulate mechanics.	Ability to browse tables and join games virtually.
P5	AR support to enhance physical interactions.	Better integration between voice chat and digital play.
P6	Support for balancing mechanics, integrated statistics.	Ways to track and analyze playtester feedback.
P7	Mass asset creation, easier rule customization.	Better automation for playtesting rules.
P8	Better automation, improved TTS integration.	Server-side improvements for smoother online play.
P9	Integration of real-world data into digital playtesting.	Better collaborative playtesting environments.

Beyond playtesting, many participants focused on features enhancing the game design process itself, particularly in the areas of asset creation and management. Making the process of these tasks smoother was a key concern, with suggestions for features like mass asset creation to speed up prototyping (P7), easier rule customization to facilitate rapid iteration and experimentation (P7), and better integration of digital components to create a more seamless workflow between digital design and physical production (P8). Technical improvements were often also part of the conversation, reflecting a desire for more robust and feature-rich digital platforms. More specifically, participants suggested enhancements like increased server-side stability to ensure smooth online playtesting and collaboration (P3, P8), improved text-to-speech integration for enhancing accessibility and immersion (P8), and physics-simulated mechanics for supporting dexterity games (P2). One participant also discussed the potential integration of augmented reality (AR)

to bridge the gap between digital and physical gameplay, facilitating physical interactions and the creation of hybrid experiences (P5). Finally, the importance of collaboration and data analysis was highlighted, with several participants suggesting the integration of tools for real-world playtest data analysis to provide a more comprehensive understanding of player behavior (P9), improved playtester feedback tracking to efficiently manage and utilize player input (P6), and enhanced voice chat integration to facilitate communication and discussion during remote playtesting sessions (P5).

5 Discussion

This section focuses on discussing the findings produced by the study as presented in the previous section. We also refer to themes that emerged during the interview, aligning the research study with the current technological trends and explore their potential in the context of this work. Moreover, combining this research and literature review we provide a set of features and specifications for the ideal board game creation tool. Finally, we discuss the potential of the latest technological advancements, namely XR and AI, address current limitations and significantly improve the creative process.

Although the number of participants in this study was limited, the findings provide valuable preliminary insights into the challenges faced by designers and the potential of emerging technologies to address them. With this in mind, it is important to note that further research and ongoing engagement with the design community are necessary to validate these findings and to uncover additional insights that could refine and expand upon these initial results.

5.1 Expanding on our previous results

While the survey provided valuable quantitative data and identified key trends, the interviews were crucial in enriching our understanding of board game design practices, moving beyond "what" to "why" and "how". More specifically, interviews provided crucial context and reasoning behind designer choices. The survey was able to identify popular tools and remote playtesting desires, but was not able to explain the rationale behind the designers' choices and requirements, a fact which seems to have been addressed by the interviews.

Starting with the design process, the analysis reveals a diverse landscape of board game design approaches, underscoring the absence of a single, universally applicable method. Each creator brings a unique perspective and process, often shaped by experience, to the table (See Table 1). Inspiration can strike from anywhere, whether it's a compelling core concept, a captivating theme, a novel mechanic, a specific component, or even a catchy title. This dynamic and creative process emphasizes that there is no "silver bullet" for game design. The fluidity inherent in the process, while fostering innovation, also presents a significant challenge: juggling the intricate interplay of concept, theme, mechanics, and components to achieve a balanced and engaging final product. This delicate balancing act, as one participant noted, is often the most demanding aspect of game design.

Moving on to the aspects related to time and cost, playtesting consistently emerges as the most time-consuming and expensive phase of board game development. The significant time investment

stems from the iterative nature of design and playtesting cycles, whether it's the sheer number of physical playtest rounds or the frustratingly slow pace and limitations of digital tools like Tabletop Simulator, which, despite reducing some costs, struggle to replicate the nuances of in-person play. Cost-wise, physical prototyping and playtester recruitment, especially compensation, represent major expenses. Beyond the financial burden, simply finding and recruiting suitable playtesters poses a significant challenge. Despite these hurdles, designers recognize the crucial value of external feedback, with some highlighting the benefits of implementing various types of playtesting, such as blind playtesting and testing with inexperienced players to uncover hidden issues and improve clarity and usability.

Finally, while the majority of surveyed board game designers utilize digital tools, particularly for the highly valued remote playtesting capability, opinions on their overall role in the design process are mixed. Digital tools are seen as useful for early prototyping, asset creation (including AI assistance), and remote collaboration, enabling access to wider playtesting audiences and facilitating modifications. However, a significant portion of designers still prefers physical playtesting, and even those using digital tools often emphasize the continued need for hands-on testing. A key insight is that digital playtesting, despite its advantages, can be significantly slower and less intuitive than physical play, sometimes doubling the required time and feeling less natural, highlighting the limitations of current digital platforms in fully replicating the tactile experience of in-person gaming.

In conclusion, while the survey identified broad trends, interviews provided essential depth, context, and solutions-focused insights. The data derived from the interview analysis, significantly enhances the research, offering a more comprehensive understanding of designer needs than either method alone.

5.2 Defining specifications

In this section, we have compiled a set of functional specifications for future board game creation tools. This compilation was based on insights from our previous survey [10], the findings of the current work discussed in Section 5.1, and the features suggested by participants in Section 4.4.2, as well as current technological trends like XR technologies and AI systems. It is worth mentioning that Table 5 covers the needs and requirements that emerged from the interviews with the board game creators and its purpose is not to provide a complete and comprehensive list, but rather suggests a set of features as a reference for the design of relevant tools.

5.3 Future work

This study highlights the partial inability of digital tools to fully address the challenges of the early stages of the game design process, largely due to its inherent complexity and diversity. However, recent advancements in AI, particularly in large language model (LLM)-based tools, have demonstrated potential in supporting creative processes at these early stages by acting as brainstorming partners and digital assistants. Notably, some participants in our study already reported using generative AI while designing and playtesting their board games. This suggests that integrating AI-driven

assistants into board game design tools could provide efficient alternatives for tackling difficult design tasks and offer solutions to persistent challenges that remain unaddressed. Future research should explore the optimal ways to incorporate AI into these tools, ensuring they enhance rather than constrain creativity.

Another key insight from the interviews, is the emphasis placed on the advantages of physical playtesting over its digital counterpart. The data generated from digital playtesting sessions is not always accurate or reliable due to the medium's inherent limitations, which can, in turn, impact critical design decisions and the overall quality of the final game. The most notable drawbacks include the absence of natural interaction with the game environment and the lack of social dynamics, both of which are fundamental to board game experiences. Recent research has highlighted the potential of eXtended Reality (XR) in addressing these challenges. XR environments can enhance social presence [4, 14] and communication cues [19], allowing users to express themselves naturally through gestures [20] and facial expressions [7]. They also enable realistic interactions with virtual objects using physics-based mechanics, creating social experiences that feel more like real-world interactions [5, 6, 13]. By leveraging these advancements and prioritizing user-centered experience design, XR holds the potential to transform playtesting practices, bridging the benefits of digital tools with the authenticity of real-world interaction. Future work should explore how XR can be effectively integrated into board game design workflows, ensuring both efficiency and meaningful engagement in the iterative design process.

6 Conclusions

Board game design is a complex and iterative process that relies on creativity, and extensive playtesting. While digital tools have emerged as valuable assets in supporting design and prototyping, they still fall short in fully addressing the nuanced challenges of board game creation—particularly in early-stage ideation and playtesting. Through a combination of survey data and in-depth interviews, this study has made a start in identifying key limitations of current digital tools, as well as the essential features that future platforms should incorporate to better support designers. Our findings emphasize the importance of balancing digital and physical playtesting, as well as the potential of emerging technologies like AI and XR to bridge existing gaps. Moving forward, continued research and collaborative engagement with the design community are essential to refine and build upon these initial insights, focusing on integrating technological advancements in ways that empower the creative workflow of board game designers. By aligning technological innovation with the needs of creators, the next generation of design tools can foster a more efficient, engaging, and accessible game development process.

Board game design is an art of balancing mechanics, creativity, and human interaction. As technology and creativity continue to intertwine, the ultimate challenge remains the same: finding the right pieces to complete the puzzle.

Table 5: Specification for digital board game creation tools, as derived from the insights of the study

Category	Feature	Description
Component Design		
	Asset Templates	Predefined and custom templates for different types of assets.
	Component Customization	Adjust colors, materials, etc., of default components (e.g., dice).
	Custom Metadata	Custom metadata fields for defining additional information, facilitating organization, and enabling functionalities, such as game balancing.
	Data Binding	Bind metadata to visual elements for dynamic updates.
	Asset Dimensions	Maintain real-world asset dimensions with zoom functionality.
	Physics Properties	Define physics properties for components.
	Physical Asset Creation	Produce digital assets for easy transfer to physical components (print layouts, grids).
Game Mechanics		
	Physics-simulated interaction	Interact with virtual components in a physics-based way, simulating friction, gravity, other forces, etc.
	Automated Actions	Provide sets of standard actions for commonly-used components (e.g., card shuffling).
	Drawable Components	In-game ability to draw or write on virtual components.
Game Design		
	Search Functionality	Search for components, assets, etc.
	Visual Scripting	Implement game logic visually.
	Component Positioning	Precise x, y coordinates, rotation, and stacking priority on the virtual table.
	Dynamic Updates	Instant game changes without reloading the game.
	Game Reskinning	Easily create new versions of a game by changing visual elements.
	Runtime Brainstorming	In-game experimentation by dynamically adding components and testing things out.
Playtesting		
	Automated Feedback	Custom questionnaires for anonymous playtester feedback.
	Note Taking	In-game note taking for rule and design updates.
	Session Recording	Record in-game playtesting sessions.
	Easy Game Access	Streamlined game sharing and access (invites, friend lists).
	On-the-Fly Design	Add/modify rules and components during playtesting.

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AI has been used to generate formatted tables in LaTeX, as well as provide more condensed versions of some paragraphs to help authors meet the manuscript's length requirements, which were, however, edited again afterwards. It has also been used to transform some references to BibTeX format.

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