Children in participatory game design

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Abstract

Studying participatory design by children in game development is crucial for creating better, more engaging, and educational games. It empowers children, fosters creativity, and leads to products that are more aligned with their needs and desires. Moreover, it provides valuable insights for both the gaming industry and broader fields of child development and educational research.

This thesis explores the roles of children as participants in game design. Additionally, it investigates the impact of game creation systems (GCS) – platforms enabling individuals to design and create games with minimal technical expertise – on game design. This study utilizes a narrative literature review methodology to investigate the roles children play in participatory game design, and how GCS influence their engagement and the outcomes. A comprehensive search was conducted across multiple databases using various queries. A systematic refinement process was then applied to ensure relevance and publication quality, ultimately resulting in the analysis of 20 relevant studies.

The findings reveal that children primarily serve as design partners and informants in participatory game design processes. Although a comprehensive understanding of the effects of game creation systems (GCS) remains complex and was not fully addressed, the study suggests increased engagement and the development of technical skills when children are actively involved in the entire game design and creation process. Additionally, a distinction was observed between the game topics chosen by children and those chosen by adults.

This research contributes an informative overview of the involvement of children in game design, shedding light on their roles as design partners and informants. Given the expansive nature of the game creation domain, the study underscores the need for further research into this many-sided topic, recognizing the potential for continued exploration and expansion of knowledge in this evolving field.

Keywords
children, participatory design, game design, game creation system

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Contents

1. Introduction

Digital gaming industry is growing with more and more children playing. In 2020–2021, Finnish children and adolescents aged 10–24 spent an average of about 1 hour per day playing digital games, boys aged 10–14 up to 1,5 hours a day (Tilastokeskus, 2021) and in 2022, of children aged 10–19 over 42 % said they play digital games daily, and over 76 % play digital games at least weekly (Kinnunen et al., 2022). Globally, the market revenue for digital games is projected to reach USD 334 billion in 2023 (Statista, 2023).

The author of this study is a parent of two children who actively engage in digital gaming. These children are mainly interested in creative games, providing them with opportunities to modify their gaming experiences according to personal preferences or create entirely new content. Notably, the elder child has ventured into game development by programming, showing a positive involvement in crafting their own digital games. Both children share their ideas for enhancing and modifying the games they engage with, highlighting a noteworthy level of participatory engagement in their digital gaming pursuits. This motivated to study the participation of children in game designing further.

Game designing can be educational in and of itself, teaching children e.g., technical, and social skills as well as the subject of the game (Cucinelli et al., 2018; Gershenfeld, 2011; Khaled & Vasalou, 2014). Games can be used in educating children on complex or serious subjects (Bossavit & Parsons, 2016; Danielsson & Wiberg, 2006; Khaled & Vasalou, 2014; Leong et al., 2021; Maqsood & Chiasson, 2021), or help them communicate their skills, questions, and feelings through play, which is more natural to them (Barwick et al., 2018; Kayali et al., 2015; Livingstone et al., 2023). Particularly for educational or serious purposes, the game's design should include the users to make the game easy to use, understandable, and interesting, so they want to play the game (Khaled & Vasalou, 2014).

Druin (2002) points out that children are not just miniature adults, but have their own interests, culture, and needs, and adults may not always identify exactly what children need or want from technology. As more and more children play, and since there is no game without players, the objective of creating user-friendly, engaging, and fun games is a goal for game studios (Wanick & Bitelo, 2020). Whether children are participating in game designing, and in what extent, emerged the first research question:

1) In what roles are children participating in game design?

Different game creation systems, such as Unity, Scratch, Minecraft or Roblox are growing in popularity (Clement, 2023). These systems aim to make game development or content creation easy regardless of existing skills, providing readily made resources such as sound and images, or making game programming easier (Chamillard, 2006; Chatain et al., 2019; Davis & Choo, 2014). This enables anyone to become a game creator instead of just professional game studios. When children are provided with accessible tools for self-creation, it is suspected that this "learning by doing" leads to a more profound level of engagement. This forms the basis for the second research question:

2) Do game creation systems affect the participation of children in game development?

Game creation systems may offer the creator nearly limitless means of expressing themselves (Chamillard, 2006; Chatain et al., 2019). When children design games for

themselves, the outcomes provide valuable insights into their interests and culture. Comparing these outcomes to game topics and genres chosen by adults may reveal a disparity between the interests of children and adults, as suggested by Druin (2002). Thus, the third research question was:

3) What kind of games are children involved in creating using game creation systems?

The structure of the thesis is as follows: The next section outlines the used research methods. In chapter 3, main concepts used in the study and previous research are introduced. Finally, chapters 4 and 5 review the findings through the lens of the research questions.

2. Research methods

The research was done as a narrative literary review, to critically review and summarize the relevant research on participatory game development. Narrative literary review is not as thorough as a systematic review but can focus on a selection of relevant studies, creating an overview on the topic. (Rhoades, 2011).

Table Table **1** below illustrates the search queries used in this study, and the numbers of results from each query. Oula-Finna e-article and e-book search was done with "peer-reviewed" and "full-text" options selected, Google Scholar search with no additional options selected, and Scopus search within all fields.

Table 1. Search query steps

Phase of search	Search query	Results, Google Scholar	Results, Oula-Finna	Results, Scopus	Included articles
Final dataset search 1	(child* OR teen*) AND ("participatory design" OR co-design) AND (game* OR gaming) AND ("game creation system" OR roblox OR recroom OR minecraft)	94	44	62	11
Final dataset search 2	"game design" AND (child* OR teen*) AND (participatory OR codesign OR cooperative)	~26 500	2 269	-	6
Final dataset search 3	(child* OR teen* OR adolescent*) AND ("participatory design" OR co-design) AND (digital game* OR gaming) AND ("game creation system" OR roblox OR recroom OR minecraft OR unity OR scratch)	~11 400	329	11	3

The literature was limited to studies focusing on children or teens (age at most 19 years) participating or co-designing in game design. Results that were not game design related (e.g. urban or traditional design) or involved only adults (i.e., all participants were over 19 years old), were excluded. Gamification, i.e., making a game from a serious or educational subject to increase learning, was also excluded if the literature did not also include participatory or co-designing. Literature that did not use any game creation systems (search query # 2), but was otherwise considered relevant, was not excluded to gain insight on the roles of children in game development overall, not just using game creation systems.

Figure 1 illustrates the process of narrowing down the results to gather the final dataset. Each search query results from different search engines, or 100 most relevant results were saved as separate lists. First the results were combined and deduplicated. The results were sorted based on their publication and given a Publication Forum rating (JUFO) from publication forum search at https://www.tsv.fi/julkaisufoorumi/haku.php. JUFO ratings are given from 0 to 3, with 3 being the highest and most high-quality publication. This was done to ensure the used literature was peer-reviewed and of high-quality. All results with a JUFO rating of 0 or n/a were excluded.

After the publications were given a rating, each of the article topics were examined through the set limitations of the study, and visibly irrelevant results were excluded. In the next phase the article abstracts and keywords were examined, and irrelevant results excluded. In the last phase the remaining studies were glanced through and reviewed through the set inclusion criteria.

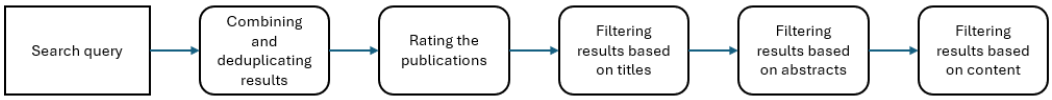

Figure 1. The process for narrowing down the search results to form the final dataset.

The final dataset, presented in Table 2, was reviewed in detail, and notes were taken on the objectives, main findings, age, number, and role of participants, and tools used in the studies. Notes were also taken on if the study produced any final product or products (namely games), what type of product or products were produced, and if the product or products were developed by the participants or an external developer, i.e., someone other than the participants themselves. These findings are further discussed in Chapter 4.

Table 2. Final dataset

#	Author(s)	Title	Summary	From Search
1	Baradaran Rahimi & Kim, 2019	The role of interest-driven participatory game design: considering design literacy within a technology classroom	How does the interest of the participant affect their engagement in designing and learning. Inside the teams the participant took on different roles as a designer, such as storyboarding or graphics designer	1
2	Baradaran Rahimi & Kim, 2023	Playce-making: transformation of space in a participatory game design project within a Canadian junior high school	Transforming actual places into digital or hybrid 'playces', ie. places to play. End products were in various forms: video games, augmented reality (AR) game and board game.	1
3	Barwick et al., 2018	Adventures with Lex: The gamification of research?	Collecting research data through a specially designed game. The design choices and the usability and understandability were closely reviewed with the focus group.	1
4	Benito-Santos et al., 2021	Playing design: A case study on applying gamification to construct a serious game with youngsters at social risk	Participatory game design process for gamification of nutrition information among pre-teen and teen girls. Used gamification elements also in the design process.	3
5	Bossavit & Parsons, 2016	Designing an Educational Game For and With Teenagers with High Functioning Autism	Design an educational geography game with and for children. Participants had high functioning autism.	1
6	Cucinelli et al., 2018	Intergenerational Learning Through a Participatory Video Game Design Workshop	Creating games in groups that have various age groups, genders, and backgrounds	2
7	Danielsson & Wiberg, 2006	Participatory design of learning media: Designing educational computer games with and for teenagers	Designing an entertaining educational game. The participants worked as design partners during the early stages, but later took the role of informant.	2
8	Downs et al., 2022	KidSpell: Making a difference in spellchecking for children	Generate an algorithm and a user interface to overcome kids' common spelling errors when searching for information. As a base for the algorithm, texts from 82 children were used to identify most common spelling mistakes for children aged 5–14 years.	1
9	Fekete & Lucero, 2019	P(L)AY ATTENTION! Co-designing for and with Children with Attention Deficit Hyperactivity Disorder (ADHD)	Create an environment for children with ADHD to be able to participate in co-designing. The participants created a game story in the last workshop.	1

10	Gennari et al., 2017	Children's emotions and quality of products in participatory game design	How do emotions of the participants affect the participation and quality of products. The participants also had subroles within the designer role.	2
11	Hava et al., 2020	Gifted students' learning experiences in systematic game development process in after-school activities	Children created games using a systematic game design approach.	3
12	Kalmpourtzis, 2019	Connecting game design with problem posing skills in early childhood	Does game designing affect problem-solving skills. The participants were younger than most other research participants.	1
13	Kayali et al., 2015	Participatory Game Design for the INTERACCT Serious Game for Health	Using gamification to create a child-friendly tool for communicating with medical personnel after cancer treatment. Children designed characters for the game, helping shape the visual style and core gameplay.	1
14	Khaled & Vasalou, 2014	Bridging serious games and participatory design	Challenge in participatory design, when designing serious games, requires expertise in both the subject and game design. The ideas children produce might not always be feasible, unique, or creative or even relate to the subject.	2
15	Laakso et al., 2021	Developing students' digital competences through collaborative game design	What roles do children assume in a cooperative game design project and what type of games do they develop. Children were asked to name the sub role they took in the desging process, such as coder, graphic designer etc.	3
16	Leong et al., 2021	Designing Video Games for Nutrition Education: A Participatory Approach	Design a game to improve children's nutritional knowledge, based on the gaming preferences of children. Research was conducted to measure the nutritional knowledge of children before designing the game.	1
17	Maqsood & Chiasson, 2021	Design, Development, and Evaluation of a Cybersecurity, Privacy, and Digital Literacy Game for Tweens	Recreating an educational game to teach cybersecurity issues for tweens. A pre-test was conducted using a similar game, revealing design flaws and outdated information.	1
18	Marchetti & Valente, 2015	Learning via Game Design: From Digital to Card Games and Back Again	Digital game design might hinder children's creativity compared to non-digital. Not all participants in game designing activities have programming skills, so the design process should include non-digital methods.	1
19	Roper et al., 2019	Collaborative Virtual Environment to Facilitate Game Design Evaluation with Children with ASC	Participants with different abilities need different tools to participate in designing technology. Most participants were children within autism spectrum conditions.	1
20	Winschiers-Theophilus et al., 2022	Pushing political, cultural, and geographical boundaries: Distributed co-design with children from Namibia, Malaysia and Finland	Participatory design should include a diverse range of people and does not have be restricted to colocation. The participants were from 3 different countries: Finland, Malaysia, and Namibia, designing a map game.	1

Common keywords in all selected studies included participatory design (9), (video) game design (9), educational/serious (video/computer) game (7), co-design/co-operative/collaborative design (6), children/teenagers/tweens (9), and gamification (3).

This study looked at the gathered literature on children in participatory game design in relation to roles proposed by Druin (2002). These roles are presented in greater detail in Chapter 3.2. Unless the reviewed literature clearly indicated the roles of the participants, the roles were examined and derived through the following guidelines:

- Participants named in the literature as co-creators or co-designers were marked primarily as Design partners.
- Participants having a strong role on the design decisions or in multiple stages of the process were marked primarily as Design partners.
- Participants actively validating or invalidating design choices were marked primarily as Design partners.
- Participants passively providing guidelines for design decisions (e.g., answering surveys) without validating or invalidating them were marked primarily as Informants.
- Participants with a minimal role in design decisions were marked primarily as Testers.

Artificial intelligence tool (ChatGPT 3/3.5) was used in this study to refine phrases in the abstract, Chapter 1 and Chapter 5. Microsoft Word “Rewrite selection”-tool was also used to refine individual phrases in other chapters. Refinements were based on existing text written by the author. All refinement was reviewed, and either partially included or completely ignored.

3. Previous research

In this chapter, the main concepts of participatory game design are presented. First, an overview of the theoretical background of participatory design is introduced. Subsequently, the various roles for children in the context of participatory design are examined. Lastly, the participatory design within game development is investigated.

3.1 Participatory Design

The field of Human-Computer Interaction (HCI) study is to improve the usability of technology, and one way to achieve that is to design the technology with the users (Druin, 1999, 2002). Participatory design (PD) or Collaborative design is a methodology that involves the users as part of the design process, utilising e.g., focus groups and workshops, resulting in mutual exchange of skills, insight and information between the users and designers (Danielsson & Wiberg, 2006; Druin, 1999, 2002).

Designing requires expertise on the subject, abstract thinking, and might require technical skills (Khaled & Vasalou, 2014; Marchetti & Valente, 2015). This is usually conquered in PD by using tangible and low-fidelity equipment such as pen and paper, toys, or modelling clay to create crude prototypes KHALED (Druin, 1999, 2002; Khaled & Vasalou, 2014). Tasks can also be eased with platforms that reduce the need for coding skills (Chamillard, 2006; Garcia & de Almeida Neris, 2022; Gershenfeld, 2011; Walsh et al., 2015). In the process participants may learn on the subject and learn other valuable skills, including technical skills, and designers can learn valuable information from the target group (Baradaran Rahimi & Kim, 2019, 2023).

The direct insights, ideas and opinions of children should be used instead of asking their guardians or teachers, as children are not small adults, but have their own norms, culture, and difficulties (Druin, 2002). Adult supervision and moderation are still needed, since children can easily wander off from the task at hand, and the ideas of children may not be suitable, reasonable, or relevant to the subject (Khaled & Vasalou, 2014; Winschiers-Theophilus et al., 2022). Interest and emotions have a defining role in participation, and the quality and quantity of the resulting ideas, so having a subject that children feel connected to is recommended (Baradaran Rahimi & Kim, 2019; Gennari et al., 2017). Participants may have troubles expressing their ideas due to their age or abilities, so the techniques used in designing should aim to conquer the special requirements of the participants and aim to include the voices of even the quiet and shy participants (Bossavit & Parsons, 2016; Fekete & Lucero, 2019; Kalmpourtzis, 2019; Roper et al., 2019; Winschiers-Theophilus et al., 2022).

Designing should include a diverse group of people to widen the variety in ideas, as digital game players include the whole spectrum of people from different age groups, geographical environments, cultures, and abilities (Bossavit & Parsons, 2016; Cucinelli et al., 2018; Downs et al., 2022; Fekete & Lucero, 2019; Garcia & de Almeida Neris, 2022; Roper et al., 2019; Winschiers-Theophilus et al., 2022).

3.2 Children's roles in participatory design

Druin (2002) suggests four roles for children in participatory design, varying in depth in involvement in the process: *user*, *tester*, *informant,* and *design partner*.

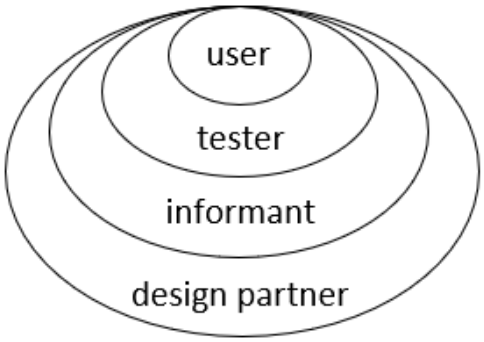

Figure 2. The four roles of children in the design process (adapted from Druin, 2002).

Figure 2 illustrates the differences in involvement between the roles. All roles also have underlying 3 dimensions describing their relationship to the design process:

1) Their relationship to adults; how do they provide information (indirect, feedback, dialogue, elaboration).
2) Their relationship to technology; what part of the design process are they targeting (ideas, prototypes, product).
3) Their goals for inquiry; what does their information help improve (developing educational theory, questioning impact of technology, better usability). (Druin, 2002)

The least involved role is *user*, where children e.g., play the game that was developed, and adults may observe the actions children take, but the product is not actively developed based on the observations, and users usually have no impact on the design they are using. The role of user in relationship to adults is indirect, being mainly a target of observation. They target the final product, but the findings are used in studying the impact of the product or future development of new products instead of improving the product at hand. (Druin, 2002)

Testers use the prototype of the product, and often feedback or observations are actively collected to improve the product before the final release. Testers have an impact on the design, but testing is usually done later in the design process, so changes are usually somewhat small. The role of tester is more direct than user, offering direct or indirect feedback. Their target is the prototype, and the findings can help improve the current product as well as provide insights for future development. (Druin, 2002)

Informants bring insight into the design process in various stages, even before any prototypes are made, such as providing information on what they do and do not know of a specific topic. Informants can have a big impact on the design and are often used in multiple stages of the process. The relationships to adults and technology, and goals of inquiry thus depend on the stage of the process they are brought in. (Druin, 2002)

Design partner is much like informant but raises the children as equal stakeholders in the design process. Design partners have more power over the final design choices made than the other roles, through negotiation between the partners. Spanning through the design process, the role of design partner has a wide relationship to adults and technology, providing all types of information on all parts of the design, but their main goal of inquiry is to help create a better design. (Druin, 2002).

The role of *co-designer* or *co-creator* is included in the reviewed literature. Co-creation can broadly be defined as any creative actions shared by two or more people and co-designing as the collaborative actions of both professional and non-professional designers in a design project (Sanders & Stappers, 2008). Uchidiuno et al. (2023) state that co-designing aims to bring balance to power relations between the designers and end users and note that this balance is most important when adults work with children. Since the definitions of co-creators or co-designers fit within the definition of a design partner, bringing all the co-creators as equal stakeholders in the design process, this study refers to those roles as *design partners* for simplicity.

3.3 Participatory game development

The gaming industry uses player-centric methods, such as testing, co-creating, and player feedback, to guide the development of games, improving the user experience, testing the game prototypes, and bringing forth new game mechanics (Wanick & Bitelo, 2020). Wanick and Bitelo (2020) observed that most previous research on PD techniques within game development is largely focused on developing serious or educational games, but not much in "full-entertaining" games in the gaming industry. They also note that the research is mostly done from an educational perspective in classrooms, or by researchers focusing on specific audiences, instead of from the player's perspective on contributing to build a better game to play (Wanick & Bitelo, 2020). PD, as a technique, is demanding and time-consuming, thus expensive, and out of most game project's reach, limiting its use in professional, revenue-based game development (Danielsson & Wiberg, 2006; Wanick & Bitelo, 2020). While professional game developers are aware of the benefits of participatory design, they seldom opt for increased consultation from the players due to time constraints, or the expected beneficial outcomes in relation to the resources needed (Wanick & Bitelo, 2020). Khaled and Vasalou (2014) suggest that the best time to use participatory design is somewhere in the middle of the design process to gain the most benefits for the design.

Jenkins (1992) introduced three categories of response tactics producers can take in fan–producer interaction – support, contempt and supervision – originally discovered in interactions between the fans and producers of TV series. Milner (2010) studied the interactions between game producers and game fans and concluded that these categories can be applied to game development as well. *Supportive* developers listen to their creative fanbase, encourage them to participate in the development process, enable them to independently extend the game concept via modding, i.e., creating game content that modifies the game experience, or generally appreciate and value the positive relationship between them and the fan community. Developers treating the fans with *contempt* ignore the feedback and can even be hostile towards user created content, e.g. striking lawsuits against fanart or taking down fan websites. *Supervision* tactics are in the middle ground, not actively encouraging participation but not condemning it either, while trying to keep the right to intellectual property. (Milner, 2010)

Open and collaborative game designing is a rising trend and an example of supportive response to interaction. In open development, developers publicly distribute incomplete games and encourage the community to participate in the development process (Thominet, 2021). One such method is game distribution platform Steam's Early Access, that lets developers publish their game when it is still in development, but already in a playable version (Valve, n.d.). According to SteamDB statistics up to October 2023, over 1900 games have been released so far in 2023 with Early Access (SteamDB, n.d.). Games can create big and strong communities, that help the developers improve the game and

can be seen as socially bonding and collaborative activity (Hao, 2021; Wanick & Bitelo, 2020). Some controversy is raised if it is suitable for a commercial project to gain revenue from user-created content, and how to maintain the balance on power over design decisions between the users and designers (Danielsson & Wiberg, 2006; Thominet, 2021; Wanick & Bitelo, 2020).

3.4 Game creation systems

All games, to be interactive, have some kind of logic: what does a click, or pushing keyboard buttons do, how do the game characters move or what are the rules of the game. This logic must be added to the game by programming, so the program knows how to respond to user interactions. Game creation systems (GCS) are game engines (i.e. base for a game) with a set of tools and resources aiming to lower the threshold for creating games without skills in programming, or graphic or sound design, making it possible for everyone to create their own game regardless of existing skills (Chamillard, 2006; Chatain et al., 2019; Davis & Choo, 2014). Popular (Clement, 2022, 2023) game creation systems include e.g., Roblox (Roblox Corporation, 2023a), Minecraft (Mojang, 2023c), Rec Room (*Rec Room*, n.d.), Unity (Unity Technologies, 2023) and Scratch (Scratch Foundation, n.d.). Other GCSs among hundreds of others include e.g. MS Kodu created by Microsoft (Microsoft's Future Social Experiences (FUSE) Labs, n.d.), and GDevelop (Rivan et al., n.d.). GCS can be seen as an umbrella term for these types of systems, as none of the mentioned platforms are addressed as 'game creation system', but terms like 'game engine', 'social gaming platform', 'programming platform' or simply 'video game' are used. These platforms also have social elements: creators can easily share their creations globally and on different platforms at the same time.

Game topics can be chosen freely, although due to social elements, some have policies or standards that the creators need to follow, limiting the topics or content based on the age of the target users, or preventing e.g., harassment, discrimination, or demeaning serious matters (Mojang, 2023a; Roblox Corporation, 2023c). Despite these, and possible technical limitations, the freedom to develop the game that the creator is interested in is almost limitless.

Game creation systems can be categorized multiple ways, depending on the point of view taken. One classification by game researchers at Ludoscience (Ludoscience, n.d.) suggests that all game creation systems can be sorted into 5 main groups:

- Game creation toolkit: software to create new autonomous games.
- Modding tool: software to modify an existing game.
- Level editor: software to create levels, maps, tracks etc. for an existing game.
- Misc. tool: software to create any other video game part (e.g. input methods, rules of the game or output).
- Gaming 2.0: any type of software mentioned above, that also has a sharing platform to easily share the games created with that tool. (Ludoscience, n.d.)

On the above criteria, Unity is considered a Game creation toolkit, Scratch considered Gaming 2.0, while Minecraft, Rec Room or Roblox do not even appear in the tool list. Minecraft can be considered mainly an open world sandbox game, but it has been widely used as an educational tool (*Minecraft Education for Educators | Minecraft Education*, 2024) and has possibilities to create games inside the game and teach e.g., programming (*Computer Science Resources & Lessons | Minecraft Education*, 2024). Rec Room and Roblox are mainly described as social gaming platforms but provide tools for users to

create and share their own games. While these systems may lack the ‘official’ status of a game creation system, they can be considered as such in the scope of this study: providing means to create levels or ‘games inside of an existing game’.

Kelleher and Pausch (2005) have made a taxonomy on programming language environments, dividing them into two main categories: *teaching systems*, that aim to teach programming for its own sake by making it easier for beginners, and *empowering systems,* that use programming to achieve other goals, such as creating a game (Kelleher & Pausch, 2005). Applying this taxonomy to game creation systems based on their perceived approach is suggested, as digital game design involves programming.

Game creation systems can provide the user with readily available components, such as characters, sounds and graphics, as well as simplified tools for implementing the game logic, making the tool *empowering* for the user, e.g., Minecraft, Roblox and Rec Room (Kelleher & Pausch, 2005; Mojang, 2023b; Rec Room, 2023; Roblox Corporation, 2023b). These systems focus on harnessing the creativity of the user, while making the practical creation of the games easier. Other systems, e.g., Unity and Scratch, provide tutorials and learning paths to increase knowledge incrementally, making the system *teaching* (Kelleher & Pausch, 2005; Scratch Foundation, n.d.; Unity Technologies, 2023).

4. Discussion

This chapter answers the research questions on the thesis: 1) In what roles are children participating in game development? 2) Do game creation systems affect the participation of children in game development? And 3) What kind of games do children create when using game creation systems?

Table 3 below summarizes the findings from the 20 research articles reviewed in this study in relation to the research questions. In Chapter 4.1, we discuss the primary roles of the participants (Table 3, Column 5), addressing the first research question. Whether the participants developed the games themselves or relied on an external developer (Table 3, Column 7), and the use of Game Creation Systems (GCS) (Table 3, Column 6) and their impact on participant engagement are examined in Chapter 4.2, addressing the second research question. Chapter 4.3 examines the third research question, exploring the various types of games created (Table 3, Column 8), and the topics that these games covered (Table 3, Column 9).

Table 3. Overview of the studies examined in this thesis.

#	Study	# of partici-pants	Age of partici-pants	Main role(s)	GCS used	External developer	Type(s) of game(s) created	Game topic(s)
1	Baradaran Rahimi & Kim, 2019	27	14–15 years	Design partner	Minecraft, Unity	no	Minecraft, augmented reality (AR), board game, card game	fighting game, memes, role-playing
2	Baradaran Rahimi & Kim, 2023	27	14–15 years	Design partner	Minecraft, Aurasma	no	Minecraft, augmented reality (AR), board game	zombie game, adventure game
3	Barwick et al., 2018	36–48	7–10 years	Informant, Tester	N/A	yes	quiz	legal matters for children
4	Benito-Santos et al., 2021	22	15–17 years	Design partner	Unity	yes	platformer	nutrition information
5	Bossavit & Parsons, 2016	7	15 years	Design partner, Tester	N/A	yes	N/A	geography
6	Cucinelli et al., 2018	30	7–75 years	Design partner	Scratch	no	N/A	local history
7	Danielsson & Wiberg, 2006	8	13–15 years	Informant	N/A	yes	quiz	interpersonal matters
8	Downs et al., 2022	10	6–11 years	Informant, Design partner	N/A	yes	search engine	information seeking
9	Fekete & Lucero, 2019	4	7–10 years	Design partner	N/A	yes	N/A	N/A
10	Gennari et al., 2017	35	8–10 years	Design partner	N/A	no	N/A	“Village without edges”
11	Hava et al., 2020	15	11–15 years	Design partner	MS Kodu	no	labyrinth, platformer	educational
12	Kalmpourtzis, 2019	18	5–6 years	Design partner, Tester	N/A	no	platformer	N/A
13	Kayali et al., 2015	81	8–14 years	Design partner	N/A	yes	questionnaire	communicating with medical personnel
14	Khaled & Vasalou, 2014	16	9–11 years	Design partner	N/A	yes	adventure	conflict solving

15	Laakso et al., 2021	98	10–17 years	Design partner	Scratch, GDevelop, Unity	no	platformer, labyrinth, adventure, car game	adventure, collect resources, shooter, fighting
16	Leong et al., 2021	62	7–11 years	Informant, Design partner	N/A	yes	adventure	nutrition information
17	Maqsood & Chiasson, 2021	63	10–13 years	Design partner	N/A	yes	quiz	cybersecurity
18	Marchetti & Valente, 2015	5	9–13 years	Informant, Design partner	N/A	no	card game	platformer into a card game
19	Roper et al., 2019	28	8–14 years	Informant	N/A	yes	virtual reality (VR)	game reviewing
20	Winschiers-Theophilus et al., 2022	6	12–15 years	Design partner	N/A	yes	map game	geography

4.1 Children's roles in game development

In the studied research projects children were mostly (n = 14) used as **design partners** as their primary role (Baradaran Rahimi & Kim, 2019, 2023; Benito-Santos et al., 2021; Bossavit & Parsons, 2016; Cucinelli et al., 2018; Fekete & Lucero, 2019; Gennari et al., 2017; Hava et al., 2020; Kalmpourtzis, 2019; Kayali et al., 2015; Khaled & Vasalou, 2014; Laakso et al., 2021; Maqsood & Chiasson, 2021; Winschiers-Theophilus et al., 2022). The role of design partner was in an important role, for example, when dealing with serious and complex topics, such as cybersecurity (Maqsood & Chiasson, 2021), health issues (Kayali et al., 2015) and nutrition (Benito-Santos et al., 2021), ensuring that the design, content and usability of the game is accessible, understandable and engaging for the children that the game was designed for.

Second most used primary role (n = 6) was **informant** (Barwick et al., 2018; Danielsson & Wiberg, 2006; Downs et al., 2022; Leong et al., 2021; Marchetti & Valente, 2015; Roper et al., 2019). For example, Downs et al. (2022) relied heavily on their informants when collecting data to create an algorithm that can reliably fix typical spelling errors that children make when typing. Moreover, e.g. legal matters (Barwick et al., 2018) and nutrition education (Leong et al., 2021) required preliminary information gathered from informants to gain insight into the current level of knowledge for children on those topics.

Some studies also had children as testers, either as a formal role or as self-assigned role, testing other groups' games. Testers were usually different individuals from the designers. For example, in Badaran Rahimi and Kim (2019), children as a self-assigned role tested the games that other children had created and gave valuable information about what they liked and how to improve the games. Bossavit and Parsons' (2016) participants acted as formal testers in the first half of one session, playing the game and revealing bugs and missing parts, then proceeded to designers in the later part of the session, discussing the gameplay and features to improve.

The roles of participants could also vary during the whole design process, changing from design partner in the beginning to informant in later stages (Danielsson & Wiberg, 2006), and participants would also attribute themselves sub roles, such as storyteller, graphic designer, or programmer, within their design group (Baradaran Rahimi & Kim, 2019, 2023; Cucinelli et al., 2018; Gennari et al., 2017; Laakso et al., 2021). This enabled each of them to focus on their strengths or fields of interest and exchange their knowledge and skills with other team members.

When having a prearranged topic and product to be improved, children generally brought important insights to the design, such as providing important preliminary information on their existing knowledge on the subject as informants, creating characters that they can relate to as design partners, and making the games more usable and understandable for them as testers, informants, and design partners (Barwick et al., 2018; Bossavit & Parsons, 2016; Danielsson & Wiberg, 2006; Druin, 2002; Fekete & Lucero, 2019; Kalmpourtzis, 2019; Kayali et al., 2015; Khaled & Vasalou, 2014; Leong et al., 2021; Maqsood & Chiasson, 2021; Roper et al., 2019). When focused on learning and creating, the children had power on design decisions as design partners (Baradaran Rahimi & Kim, 2019, 2023; Barwick et al., 2018; Bossavit & Parsons, 2016; Cucinelli et al., 2018; Gennari et al., 2017; Hava et al., 2020; Laakso et al., 2021).

None of the reviewed literature in this study explicitly focused on the roles of children in full-entertaining games developed by the gaming industry. This could be caused by the gaming industry not interested in participating in formal studies, lack of funds in commercial production, the researchers and game producers having different goals, or the industry keeping the research results a business secret (Wanick & Bitelo, 2020). The gaming industry is highly competitive, battling for a limited amount of free time both externally between other types of entertainment, such as television or sports, and internally between different games. Creating engaging environments, where children want to spend their time requires constant work on improving existing content and creating new content to explore. The presence of game creation systems and the ease to create games shifts the users from mere consumers, subject to the decisions of the gaming industry, to equal creators among professionals (Gershenfeld, 2011; Thominet, 2021). Harnessing the power of social networks, the users can create games with masses, engaging more people than any game studio could financially withstand (Hao, 2021; Milner, 2010; Thominet, 2021). This does not mean that game creation systems and the gaming industry exist as distinct and competing things. For instance, games like Minecraft, Roblox, and Rec Room are products of profit-oriented gaming studios, which now gain profits from sourcing a significant portion, if not the majority, of their content from the community.

Thominet (2021) and Milner (2010) have studied the interactions between the developers and users of two commercial, entertaining games when the games were in development. Both studies examined, independent from the developing companies, how the users, i.e., fans of that game, brought forth their ideas on how to improve or develop the game, participating in game development. Milner (2010) focused on the tone of interaction the fans were engaging in the conversation: *consular/managerial* – fans acting as opinion leaders in regards to the story and gameplay, *antagonistic/adversial* – fans doubting the game developer company to create a quality game, *cynical/jaded* – fans determined that the game will be low quality no matter what, and *deferential/respectful* – fans showing confidence in the decisions of the developers. Thominet (2021) in their study identified 6 different actor roles from the interactions:

- Consumers, seeking information about the game
- Players, describing their personal playing experiences and seeking help
- Community builders, helping other community members
- Quality Assurance (QA), finding and describing errors in the game
- Playtesters, describing potential adjustments to gameplay experiences
- Co-designers, having a significant role to the design or gameplay (Thominet, 2021).

The tones of interaction could not be clearly seen in the reviewed literature, as none of the literature was focused on observing the interactions between the participants and the possible developers. The 6 roles found in Thominet's (2021) research can be loosely fitted inside the roles proposed by Druin (2002). Consumers and players can be seen as *users*, having a minimal effect on the development, community builders can be seen as *informants*, using their knowledge to bring valuable information to the development, QA and playtesters can be seen as *testers*, finding errors and testing the prototypes, and as proposed earlier in Chapter 3.2, co-designers can be seen as *design partners*. While this inclusion can be debated and is in no way systematic, it shows that Druin's (2002) proposed roles can also be found in professional game development. While these studies on interaction between the developers and users were not specifically focused on children, as children are playing professionally developed, full-entertaining games in great numbers, it is probably safe to assume that at least some of them are participating in professional game development as fans and community members in some form. Children are also adept users of social media, having grown up in the digital era, so they are presumably participating in some form of communication with the commercial gaming development. The exact numbers or roles could not be found within the literature in this study.

Based on the reviewed literature, the role of informant seemed more passive than the role of design partner. Design partners were closely involved in the projects throughout, giving feedback on or negotiating the design choices, and validating the changes made based on that feedback. Informants had a more passive role, providing background information but not validating the choices made based on their feedback. Even if they had a strong impact on the choices, the final decisions were made by adults. This seemed to impact the participants' learning; there is a significant difference between merely filling out a survey and actively searching for information and then applying that knowledge. The role of design partner seemed to be more beneficial to both the children involved and the design outcome: empowering the children to learn and be heard and creating a better design.

Druin (2002) points out that no role is superior to the other, and each role children partake in a project have both challenges and benefits. Children can be very honest in their feedback, so the challenges for the researcher or developer is to cope with negative feedback on something they possibly took months to create. The timing on when to bring children in the design process to gain most benefits can also be challenging. Teachers, researchers, and designers need to address that working with children takes time and patience, and the outcomes are not always what they expect – for better or worse. The challenges for children can be that the adults are, apart from design partners, ultimately in charge of the final decisions, and feel like their opinions are not heard. (Druin, 2002)

Benefits for participatory design with children are numerous. Different roles can provide researchers and developers innovative results quickly for a minimal amount of time used. Teachers may be able to learn from the design processes and utilize the techniques for other educational situations in the future. Children feel empowered, that they are heard and taken seriously by adults and see that they are not merely users of technology but can be a part of its design process. (Druin, 2002)

Not all projects can support participatory design, let alone throughout the project. Each design project could benefit from participatory design, but the intensity of participation must be weighed against the realities of the time allocated for the project. Thus, having different roles for children in different parts of the projects will depend on these restrictions. All reviewed studies concluded a positive outcome from including children

in the design process regardless of their role, whether it was towards future development, developing the techniques for participation, gaining a usable and intriguing product or seeing children learn.

4.2 Effects of game creation systems in the participation of children in game development

Some game creation systems, such as Minecraft or Roblox, are familiar to children as games, so using them as tools in participatory design creates new and more effective ways to design (Walsh et al., 2015; Xinliu & Wang, 2023). Digital environments can help children with social challenges have their opinions heard in a way that is comfortable for them (Bossavit & Parsons, 2016; Fekete & Lucero, 2019; Roper et al., 2019), and bring together large, global audiences (Hao, 2021; Thominet, 2021; Walsh et al., 2015; Winschiers-Theophilus et al., 2022). In addition, familiar tools that children are motivated and interested to use even for longer periods of time help increase their creativity (Roper et al., 2019; Walsh et al., 2015; Xinliu & Wang, 2023). The familiar setting of a game environment could also decrease the threshold of moving from player to creator even with limited technical skills (Chamillard, 2006; Davis & Choo, 2014; Gershenfeld, 2011; Kelleher & Pausch, 2005).

Game creation systems were used in designing games in multiple (n = 6) studies examined (Baradaran Rahimi & Kim, 2019, 2023; Benito-Santos et al., 2021; Cucinelli et al., 2018; Hava et al., 2020; Laakso et al., 2021). In all these studies the participants acted as **design partners**, and in all but one created their games without external game developers (Table 3; Druin, 2002). In addition to Minecraft, Unity, Scratch, MS Kodu and GDevelop, some studies used digital tools to create games but did not specify the name of the system used (Barwick et al., 2018; Khaled & Vasalou, 2014; Leong et al., 2021) or the tool was not considered a GCS, e.g. web-app development (Bossavit & Parsons, 2016; Maqsood & Chiasson, 2021; Roper et al., 2019; Winschiers-Theophilus et al., 2022).

Across the reviewed literature, 12 game designs used external game developers (Table 3), i.e., the children did not produce the digital game themselves, but helped guide the design decisions either as **design partners** (n = 7) or **informants** (n = 5) (Barwick et al., 2018; Bossavit & Parsons, 2016; Danielsson & Wiberg, 2006; Downs et al., 2022; Druin, 2002; Fekete & Lucero, 2019; Kayali et al., 2015; Khaled & Vasalou, 2014; Leong et al., 2021; Maqsood & Chiasson, 2021; Roper et al., 2019; Winschiers-Theophilus et al., 2022). Four of these projects stated that they used professional game designers to develop the prototypes, final game design, or both (Barwick et al., 2018; Danielsson & Wiberg, 2006; Khaled & Vasalou, 2014; Maqsood & Chiasson, 2021). In the remaining 8 projects, the game, prototype, or both were developed by the researcher, research team, or the developer was not specified. All these 12 projects were educational or serious games. These finding implicate that children do not always participate in the design as deeply as they could when co-creating with an external developer or are not heard as equal stakeholders when making decisions. On the other hand, using an external developer can still deeply engage children in the design process, but the actual programming of the game is outsourced for e.g., getting the product ready in time.

When using game creation systems, the involvement in the process can be deeper than just co-designing with an external developer, giving the children a hands-on experience in learning. In some studies (Baradaran Rahimi & Kim, 2019, 2023; Cucinelli et al., 2018; Hava et al., 2020; Laakso et al., 2021; Walsh et al., 2015), the power to create seemed to enhance the role of **design partner,** giving children power on making the design

decisions themselves. According to the participants in Badaran Rahimi and Kim (2019, 2023) and Laakso et al. (2021), they had learned technical, teamwork, and management skills more than they assumed they would have learned in a structured setting, and they were more interested in participating in the process. Creating a game from appealing and interesting ideas and tackling technical skill challenges positively affected the intensity of their participation, creating a rewarding, empowering, and educational outcome (Baradaran Rahimi & Kim, 2019, 2023; Hava et al., 2020; Laakso et al., 2021). Additionally, Cucinelli et al. (2018) observed an increase in the participants' perception of their programming skills after they had created games with Scratch.

Reflecting on the taxonomy of programming languages by Kelleher and Pausch (2005), these experiences could be seen as both *empowering* and *teaching* for the participants, as they both achieved their goal of creating a digital game using a game creation system and learned new technical skills through designing. One participant in Badaran Rahimi & Kim (2019) even wanted to pursue in game development as their future career due to positive experiences during the game design process. Providing hands-on learning for children can be considered a valuable investment, resulting in a diverse range of skills.

Despite the advantages of using GCS in participatory game design, there are still limitations to be acknowledged. Even though GCS aim to have a low learning curve, they still require some learning, and not all children are motivated by programming. Some GCS have technical limitations, making them unsuitable for all purposes, and the end results may not be as detailed or professional as expected. The technical requirements for the game may exceed the skills of the children, or time constraints may require the use of a professional developer.

4.3 Games created with game creation systems

Whether the participants in the reviewed studies improved a set game idea or could freely choose a topic for their game influenced the game topics. In the reviewed studies where the game topic was predetermined, and intentionally educational or serious (Barwick et al., 2018; Bossavit & Parsons, 2016; Danielsson & Wiberg, 2006; Laakso et al., 2021; Leong et al., 2021; Maqsood & Chiasson, 2021), e.g. legal matters, nutritional health, or cybersecurity, children learned on the topics alongside making the game more appropriate and entertaining, even if they did not choose the topic themselves, or did not have a very strong power over the final design choices. The overall responses among children to these educational or serious games was positive throughout these studies, stating the topics to be useful to children.

When choosing their own topics (Baradaran Rahimi & Kim, 2019, 2023; Hava et al., 2020; Laakso et al., 2021; Marchetti & Valente, 2015), the ideas for games tended to be more "full-entertaining", including zombie killing games, shooting games, fighting games, meme games, role-playing games, war games and resource collecting. In some studies, like Bossavit and Parson (2016), researchers or teachers moderated the ideas of children, since i.e., violence (i.e., bombing other countries) was not considered an appropriate way to learn geography. Hava et al. (2020) narrowed their participants' game topics to be educational, but let the groups decide on which topics they wanted to address, resulting in children choosing topics they knew their peers are struggling with.

The selection of entertaining game topics may be influenced by their familiarity and personal appeal to children. For example, if children frequently play and enjoy car games, they are more likely to create a game on a similar theme. Entertaining topics may also

provide children with easy and quick gratification, as they are more likely to experience immediate enjoyment and satisfaction from engaging with themes they find appealing, rather than struggle with unfamiliar or unpleasant topics.

These findings seem to implicate a gap between the interests of adults and children when designing games for children, as was suspected when forming the research question. According to a survey study by Livingstone et al. (2023), children like their digital games to be stimulating, diverse, and give a sense of achievement. For example, in their study, none of their respondents explicitly stated that they want to play digital games to learn new things (Livingstone et al., 2023), which could possibly mean that children, when freely choosing the game to play, either do not specifically want to learn while playing, or that they do not notice the possible educational aspects of entertaining games. Children in the reviewed studies tended to seek entertainment in their produced games, while adults aimed for educating through gamification. However, this gap could be caused by the lack of literature focusing on developing full-entertaining games with children in this study and in the field overall, and having a limited set of data, these implications cannot be generalized.

Many participants in the reviewed studies tended to choose to design a platformer or labyrinth type of game, i.e. collecting resources such as coins or keys, advancing from one view (e.g., level or screen) to another, possibly avoiding or removing obstacles or adversaries. This type of game was the most selected type of game in the reviewed studies overall (n = 4) and present in most (n = 3) of the studies reviewed where the end products were introduced and children created the games themselves using GCS as a tool (Table 3). It seemed to be popular for its simplicity; while children would have liked to create more complex games, the lack of technical skills, the limited amount of time available and the tools used affected the type of game the children were able to create. Some participants had to alter the game concept or final implementation to fit the tool used or the level of their collective technical knowledge, even resulting in a non-digital product to be able to finish the product despite technical challenges (Baradaran Rahimi & Kim, 2019; Hava et al., 2020; Laakso et al., 2021). Using Minecraft as a tool (Baradaran Rahimi & Kim, 2019, 2023) aimed to diminish the challenges with game programming, enabling children to focus on the game story and environment, and allowing them to create their own story inside a readily available game mechanic.

While the studies reviewed give a preview of what types of games and game topics children choose when having the technology and the freedom, more research on the topic is needed, especially when using social gaming or programming platforms such as Scratch, Rec Room or Roblox to easily share the games to others.

5. Conclusions

This thesis employed a narrative literature review methodology to critically assess and summarize research on participatory game design involving children. The research utilized search queries across different databases which were designed to capture a range of studies related to participatory game design and Game Creation Systems (GCS). The search yielded a variety of results, which were then refined through a multi-step process involving deduplication, quality assessment, and relevance filtering. The final dataset was meticulously reviewed for studies focusing on children or teens involved in game design. Studies were excluded if they did not meet the requirements, such as being unrelated to game design or involving only adults. The review process also included an evaluation of publication quality and an analysis of the roles children played in the studies.

Previous research reviewed in this study reveals that children are engaging in participatory game design and are considered a valuable part of the design process. Participatory game design offers several advantages: it enhances the overall quality of the product, expands the knowledge and skills of the professionals involved, and provides children with opportunities to acquire new skills. The findings also indicate that active participation in the entire game design and creation process enhances engagement and promotes the development of technical skills among children. Additionally, the study observed a notable difference in the game topics selected by children compared to those chosen by adults.

The study addressed the roles and depth of children's participation as creators in game creation systems to a limited extent. This study was limited due to time constraints within the research project, preventing the inclusion of all eligible results. Additionally, manual reviewing of the original dataset based on titles or abstracts may have unintentionally excluded some relevant studies. It is essential to acknowledge that the final dataset was small, so the results cannot be generalized.

Future literary reviews should refine the search queries and possibly use subject area filters (computer science) – though the field of HCI is interdisciplinary and thus not only limited to computer science – and limitations to digital games to reduce the volume of initially irrelevant results.

Additional empirical research is needed, particularly in the context of social game creation platforms such as Roblox, Unity, Minecraft, or Rec Room. This further research should cover perspectives such as the quantity, quality, and diversity of games developed by children. Furthermore, a more comprehensive analysis of the roles children take in participatory game design within the gaming industry in designing full-entertaining games is needed.

In summary, this study has created an overview of the participation of children in the domain of game design, providing insights to understanding of this subject. It is important to acknowledge, however, that the field of game design is vast, so not all components within this expansive domain could be addressed in the present research. The description of children's roles in game design establishes a foundational framework, urging subsequent research to investigate the dimensions of this dynamic field, thereby fostering more comprehension of the subject.

References

Baradaran Rahimi, F., & Kim, B. (2019). The role of interest-driven participatory game design: considering design literacy within a technology classroom. *International Journal of Technology and Design Education*, *29*(2), 387–404. https://doi.org/10.1007/s10798-018-9451-6

Baradaran Rahimi, F., & Kim, B. (2023). Playce-making: transformation of space in a participatory game design project within a Canadian junior high school. *Learning, Media and Technology*, *48*(3), 387–400. https://doi.org/10.1080/17439884.2022.2059764

Barwick, J., Watkins, D., Kirk, E., & Law, E. (2018). Adventures with Lex: The gamification of research? *Convergence (London, England)*, *24*(3), 229–250. https://doi.org/10.1177/1354856516677682

Benito-Santos, A., Dorn, A., Gómez, A. G. L., Palfinger, T., Sánchez, R. T., & Wandl-Vogt, E. (2021). Playing Design: A Case Study on Applying Gamification to Construct a Serious Game with Youngsters at Social Risk. *Journal on Computing and Cultural Heritage*, *14*(2), 1–19. https://doi.org/10.1145/3427380

Bossavit, B., & Parsons, S. (2016). Designing an Educational Game for and with Teenagers with High Functioning Autism. *Proceedings of the 14th Participatory Design Conference: Full Papers - Volume 1*, 11–20. https://doi.org/10.1145/2940299.2940313

Chamillard, A. T. (2006). Introductory Game Creation: No Programming Required. *Proceedings of the 37th SIGCSE Technical Symposium on Computer Science Education*, 515–519. https://doi.org/10.1145/1121341.1121502

Chatain, J., Bitter, O., Fayolle, V., Sumner, R. W., & Magnenat, S. (2019). A Creative Game Design and Programming App. *Proceedings of the 12th ACM SIGGRAPH Conference on Motion, Interaction and Games*. https://doi.org/10.1145/3359566.3360056

Clement, J. (2022, August 2). *Minecraft number of players worldwide 2021 | Statista*. https://www.statista.com/statistics/680139/minecraft-active-players-worldwide/

Clement, J. (2023, August 9). *Top downloaded game constructors gaming titles 2023 | Statista*. https://www.statista.com/statistics/1376569/top-downloaded-game-constructors-gaming-titles/

Computer Science Resources & Lessons | Minecraft Education. (2024). https://education.minecraft.net/en-us/resources/computer-science

Cucinelli, G., Davidson, A.-L., Romero, M., & Matheson, T. (2018). Intergenerational Learning Through a Participatory Video Game Design Workshop. *Journal of Intergenerational Relationships*, *16*(1–2), 146–165. https://doi.org/10.1080/15350770.2018.1404855

Danielsson, K., & Wiberg, C. (2006). Participatory design of learning media: Designing educational computer games with and for teenagers. *Interactive Technology and Smart Education*, *3*(4), 275. https://doi.org/10.1108/17415650680000068

Davis, R. C., & Choo, K. T. W. (2014). PlaySketch: turning animation sketches into game logic. *IUI 2014 Workshop on Sketch: Pen and Touch Recognition*.

Downs, B., Pera, M. S., Wright, K. L., Kennington, C., & Fails, J. A. (2022). KidSpell: Making a difference in spellchecking for children. *International Journal of Child-Computer Interaction*, *32*, 100373. https://doi.org/https://doi.org/10.1016/j.ijcci.2021.100373

Druin, A. (1999). Cooperative Inquiry: Developing New Technologies for Children with Children. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 592–599. https://doi.org/10.1145/302979.303166

Druin, A. (2002). The role of children in the design of new technology. *Behaviour & Information Technology*, *21*(1), 1–25. https://doi.org/10.1080/01449290110108659

Fekete, G., & Lucero, A. (2019). P(L)AY ATTENTION! Co-designing for and with Children with Attention Deficit Hyperactivity Disorder (ADHD). *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *11746 LNCS*, 368–386. https://doi.org/10.1007/978-3-030-29381-9_23/FIGURES/10

Garcia, F. E., & de Almeida Neris, V. P. (2022). A framework for tailorable games: toward inclusive end-user development of inclusive games. *Universal Access in the Information Society*, *21*(1), 193–237. https://doi.org/10.1007/s10209-020-00779-8

Rivan, F., Pasteau, C., Luna, E., Sapet, A., Hélard, D., Aurélien, Codas, M., Wesley, & Tristan. (n.d.). *GDevelop: Free, Fast, Easy Game Engine - No-code, Lightweight, Super Powerful | GDevelop*. Retrieved July 21, 2024, from https://gdevelop.io/

Gennari, R., Melonio, A., Raccanello, D., Brondino, M., Dodero, G., Pasini, M., & Torello, S. (2017). Children's emotions and quality of products in participatory game design. *International Journal of Human-Computer Studies*, *101*, 45–61. https://doi.org/10.1016/j.ijhcs.2017.01.006

Gershenfeld, A. (2011). Leveling up from player to designer: engaging and empowering youth through making video games. *Knowledge Quest*, *40*(1), 54–59.

Hao, Y. (2021). Computer Games as Social Sculptures: Rethinking the Discourse of Participation and Its Implications for Digital Game Design. *Proceedings of the ACM on Human-Computer Interaction*, *5*(CHI PLAY), 1–15. https://doi.org/10.1145/3474668

Hava, K., Guyer, T., & Cakir, H. (2020). Gifted students' learning experiences in systematic game development process in after-school activities. *Educational Technology Research and Development*, *68*(3), 1439–1459. https://doi.org/10.1007/s11423-020-09750-z

Jenkins, H. (1992). *Textual poachers : television fans and participatory culture*. Routledge.

Kalmpourtzis, G. (2019). Connecting game design with problem posing skills in early childhood. *British Journal of Educational Technology*, *50*(2), 846–860. https://doi.org/10.1111/bjet.12607

Kayali, F., Peters, K., Kuczwara, J., Reithofer, A., Martinek, D., Wölfle, R., Mateus-Berr, R., Lehner, Z., Silbernagl, M., Sprung, M., Lawitschka, A., & Hlavacs, H. (2015). Participatory Game Design for the INTERACCT Serious Game for Health. In S. Göbel, M. Ma, J. Baalsrud Hauge, M. F. Oliveira, J. Wiemeyer, & V. Wendel (Eds.), *Serious Games* (pp. 13–25). Springer International Publishing.

Kelleher, C., & Pausch, R. (2005). Lowering the Barriers to Programming: A Taxonomy of Programming Environments and Languages for Novice Programmers. *ACM Computing Surveys*, *37*(2), 83–137. https://doi.org/10.1145/1089733.1089734

Khaled, R., & Vasalou, A. (2014). Bridging serious games and participatory design. *International Journal of Child-Computer Interaction*, *2*(2), 93–100. https://doi.org/https://doi.org/10.1016/j.ijcci.2014.03.001

Kinnunen, J., Tuomela, M., & Mäyrä, F. (2022). Pelaajabarometri 2022 : Kohti uutta normaalia. *TRIM Research Reports 31*. https://trepo.tuni.fi/handle/10024/144376

Microsoft's Future Social Experiences (FUSE) Labs. (n.d.). *Kodu Game Lab | KoduGameLab*. Retrieved July 21, 2024, from https://www.kodugamelab.com/about/

Laakso, N. L., Korhonen, T. S., & Hakkarainen, K. P. J. (2021). Developing students' digital competences through collaborative game design. *Computers and Education*, *174*, 104308-. https://doi.org/10.1016/j.compedu.2021.104308

Leong, C., Liesaputra, V., Morrison, C., Parameswaran, P., Grace, D., Healey, D., Ware, L., Palmer, O., Goddard, E., & Houghton, L. A. (2021). Designing Video Games for Nutrition Education: A Participatory Approach. *Journal of Nutrition Education and Behavior*, *53*(10), 832–842. https://doi.org/10.1016/j.jneb.2021.07.001

Livingstone, S., Ólafsson, K., & Pothong, K. (2023). Digital play on children's terms: A child rights approach to designing digital experiences. *New Media & Society*. https://doi.org/10.1177/14614448231196579

Ludoscience. (n.d.). *Game Creation Tools Classification : Classification guidelines*. Retrieved June 22, 2024, from https://creatools.gameclassification.com/EN/about/index.html#GENERAL

Maqsood, S., & Chiasson, S. (2021). Design, Development, and Evaluation of a Cybersecurity, Privacy, and Digital Literacy Game for Tweens. *ACM Transactions on Privacy and Security*, *24*(4), 1–37. https://doi.org/10.1145/3469821

Marchetti, E., & Valente, A. (2015). Learning via Game Design: From Digital to Card Games and Back Again. *Electronic Journal of E-Learning*, *13*(3), 167.

Milner, R. M. (2010). NEGOTIATING TEXT INTEGRITY: An analysis of fan-producer interaction in an era of digital-connectivity. *Information, Communication & Society*, *13*(5), 722–746. https://doi.org/10.1080/13691180903456538

Minecraft Education for Educators | Minecraft Education. (2024). https://education.minecraft.net/en-us/get-started/educators

Mojang. (2023a). *Community Standards | Minecraft*. https://www.minecraft.net/en-us/community-standards

Mojang. (2023b). *Minecraft: Bedrock Edition Creator Documentation | Microsoft Learn*. https://learn.microsoft.com/en-us/minecraft/creator/

Mojang. (2023c, October 19). *What is Minecraft? Build, Discover Realms & More | Minecraft*. https://www.minecraft.net/en-us/about-minecraft

Rec Room. (n.d.). Retrieved October 19, 2023, from https://recroom.com/

Rec Room. (2023). *RecNet*. https://rec.net

Rhoades, E. (2011). Literature Reviews. *The Volta Review*, *111*(1), 61–71. https://doi.org/10.17955/tvr.111.1.677

Roblox Corporation. (2023a). *Home - Roblox*. https://corp.roblox.com/

Roblox Corporation. (2023b). *Platform Overview | Documentation - Roblox Creator Hub*. https://create.roblox.com/docs/platform

Roblox Corporation. (2023c, October 3). *Roblox Community Standards – Roblox Support*. https://en.help.roblox.com/hc/en-us/articles/203313410-Roblox-Community-Standards

Roper, T., Millen Dutka, L., Cobb, S., & Patel, H. (2019). Collaborative Virtual Environment to Facilitate Game Design Evaluation with Children with ASC. *International Journal of Human-Computer Interaction*, *35*(8), 692–705. https://doi.org/10.1080/10447318.2018.1550179

Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, *4*(1), 5–18. https://doi.org/10.1080/15710880701875068

Scratch Foundation. (n.d.). *Scratch - About*. Retrieved October 19, 2023, from https://scratch.mit.edu/about

Statista. (2023). *Video Games - Worldwide*. https://www.statista.com/outlook/dmo/digital-media/video-games/worldwide

SteamDB. (n.d.). *Steam Game Releases Summary for Early Access · SteamDB*. Retrieved October 23, 2023, from https://steamdb.info/stats/releases/?tagid=493

Thominet, L. (2021). Open Video Game Development and Participatory Design. *Technical Communication Quarterly*, *30*(4), 359–374. https://doi.org/10.1080/10572252.2020.1866679

Tilastokeskus. (2021). *Ajankäyttö*. https://stat.fi/julkaisu/cl8ipicxx123r0bw2oxe42g8i

Uchidiuno, J. O., Solyst, J., Kemper, J., Harpstead, E., Higashi, R., & Hammer, J. (2023). "What's Your Name Again?": How Race and Gender Dynamics Impact Codesign Processes and Output. *ACM Transactions on Computer-Human Interaction*, *30*(6). https://doi.org/10.1145/3603624

Unity Technologies. (2023). *Game Development Software: Create 2D and 3D Games | Unity*. https://unity.com/solutions/game

Valve. (n.d.). *Early Access (Steamworks Documentation)*. Retrieved October 23, 2023, from https://partner.steamgames.com/doc/store/earlyaccess

Walsh, G., Donahue, C., & Rhodes, E. E. (2015). KidCraft: Co-Design within a Game Environment. *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*, 1205–1210. https://doi.org/10.1145/2702613.2732921

Wanick, V., & Bitelo, C. (2020). Exploring the use of participatory design in game design: a Brazilian perspective. *International Journal of Serious Games*, *7*(3), 3–20. https://doi.org/10.17083/ijsg.v7i3.358

Winschiers-Theophilus, H., Goagoses, N., Rötkönen, E., & Zaman, T. (2022). Pushing political, cultural, and geographical boundaries: Distributed co-design with children from Namibia, Malaysia and Finland. *International Journal of Child-Computer Interaction*, *31*, 100439. https://doi.org/https://doi.org/10.1016/j.ijcci.2021.100439

Xinliu, L., & Wang, B. (2023). AgroEdu Through Co-crafting: Incorporating Minecraft into Co-design Activities for Agricultural Education. In Zaphiris Panayiotis & A. Ioannou (Eds.), *Learning and Collaboration Technologies* (pp. 619–630). Springer Nature Switzerland.