Exploring the opportunities and risks of generative AI for game development: Insights from the Belgian game industry*

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Abstract

Generative AI (GenAI) tools are becoming increasingly prevalent in various industries, including the gaming industry. Some consider GenAI as the future of game development, providing opportunities for improved efficiency and automation of several aspects such as artwork generation, programming, and storytelling. Others are equally concerned with potential risks, including concerns regarding copyright, employment, and the lack of qualitative output. However, research on game industry professionals' perceptions and use of GenAI for game development is scarce, focusing on specific target groups (e.g., student and indie developers) or specific GenAI tools (e.g., image generation tools). The current paper includes exploratory in-depth interviews with 20 Belgian game developers to determine their attitudes and usage of GenAI. While some developers were cautiously optimistic about its future potential, most developers were rather skeptical about GenAI's usefulness. Developers agreed that GenAI was most useful for coding and other technical tasks over creative aspects, as a supporting tool. Moreover, use of GenAI mostly occurred during early development, drawing inspiration for name giving of in-game objects and environments, creating concept art for mood boards, or use GenAI voice lines for early prototypes. Quality concerns were mentioned most frequently, as developers criticized GenAI tools' mediocre storytelling quality, inefficient image generation, but also for providing buggy coding solutions. Employment loss was also a persistent concern, while ethical concerns regarding copyright and IP were less prevalent. Interestingly, they were also concerned about how players' interactions with GenAI-created content could lead to inappropriate situations that were out of their control. These findings are discussed within current knowledge on the topic, discussing future research opportunities and implications for game developers, educators, and policymakers.

Keywords

game development, generative AI, industry perspective, opportunities, risks

1. Introduction

Generative AI (GenAI) is becoming an indispensable part of daily life. It has the potential to promote efficiency and innovation in various industries, including the gaming industry. GenAI can automatize modelling of in-game objects and characters, or provide realistic voice lines and automatically generate NPC dialogues [1]. It might also benefit early game development, by speeding up conceptual artwork creation through image generation tools, initiate scenario writing, and accelerate prototype development via GenAI-generated scenarios and game engine coding [2]. While some might consider GenAI to be the future of game development, many are equally concerned by its drawbacks. These include copyright and intellectual property issues with GenAI-generated artwork [3], the consistent fear of decreasing employment opportunities [4], and concerns regarding the lack of authenticity and creativity of GenAI-generated storytelling [5].

Despite GenAI's recent surge in capabilities and popularity (for game development), research on the use of and attitudes toward GenAI for game development is still scarce [6]. This paper proposes that it is vital to first understand how developers themselves perceive and use GenAI technology before being able to determine how GenAI impacts game design and how to integrate GenAI in

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game development processes in the most effective and ethical ways. Such an understanding contributes toward the ongoing discussions in both in academia and industry about GenAI's place in advancing (or inhibiting) the game development industry, as well as how it transforms work-related relationships in this creative and ever-evolving environment. This paper aims to advance our knowledge of this emergent topic by conducting qualitative exploratory interviews with Belgian game developers, examining how they perceive and use GenAI tools for game development in terms of strengths, opportunities, weaknesses, and risks.

2. Related Work

2.1. Strengths and Opportunities of Generative AI for Game Development

Traditional AI—one of the core aspects of games, in which predetermined mechanisms and algorithms ensure that non-player characters (NPCs) and the game world itself respond logically to player input [7]—is seemingly becoming outdated with the rise of GenAI. This perhaps bold claim is supported on several strengths and opportunities this emergent technology can offer game developers. GenAI has the potential to automate several processes allowing developers to focus on more creative and important aspects. This automation occurs, for example, through GenAI-powered procedural generation of new and changing game environments [1], the automatized modelling of NPCs and other in-game objects, and the provision of realistic and diverse voice lines as well as automatically generated dialogues for NPCs [8], or at least generated 'chatter' as dialogue starters [9]. The action role-playing game *Cygnus Enterprises* [10], for instance, is the first full game to include a GenAI-powered companion character that responds to players in real time. Even AAA game studios are testing out these opportunities, including Ubisoft, who developed an in-house GenAI tool called *Ghostwriter* [11] to support game writers by generating first drafts of basic NPC dialogue.

Additionally, GenAI can provide aid during the *early phases of the development process* [2]. Game artists, for example, can use image generation tools like Midjourney [12] or GPT Image 1 [13] to quickly visualize their creative ideas as (early) conceptual artwork. It can also speed up scenario writing, or support development of playable game prototypes through tools such as Tabnine [14] or GitHub Copilot [15] that help developers with game engine coding.

Yet another opportunity for the integration of GenAI in game development processes lies in the *promotion stage* of the game [2], by using GenAI to devise a marketing plan and specific communication strategies aimed at the game's targeted player audience. As such, game developers could "narrow down what kind of game they want to make without the help of marketing or strategy departments by using market sensing, that is, testing what kind of format, genre, and visuals the market responds to by sending out feelers made with generative AI" (p. 229).

A fourth and final strength, situated on a more abstract level, is that GenAI's integration in game development can lead to a more *cost-effective game development* [2][5][6]. For instance, Panchanadikar et al. [5] found in their qualitative analysis of online forums dedicated to non-profit driven indie game developers that a lot of them believed GenAI could "automate mundane and repetitive tasks that would otherwise consume significant manual effort" (p. 3-4), leaving the 'fun' parts of game development for human developers. Similarly, Boucher et al.'s [3] analysis of early career game developers' perceptions on GenAI showed that GenAI tools can make repetitive aspects of their workflow easier. Related to this, the introduction of GenAI tools can also create *more competitive power for smaller, indie studios* compared to larger studios. Both industry associations such as Video Games Europe [16] and recent research [2] support the notion that generative AI tools can foster growth, especially for these smaller-team and indie game studios. By significantly reducing the cost and time it takes to develop (assets for) games, such developers gain a competitive edge. However, a certain nuance is needed here: recent studies outside of game development show that incorporating (Gen)AI into existing workflows creates additional stress and workload [17], and may even reduce productivity. For example, Becker et al. [18] found that open-source software developers using AI for coding tasks were slowed down by 19% compared to those not using AI. Nevertheless,

certain GenAI tools could enable more innovative and experimental approaches to game development, freeing studios from the pressure to create commercially safe, mainstream games for financial survival [5]. Additionally, GenAI tools can support the expansion of the indie game community within the broader game production landscape.

Important to note here is that these strengths and opportunities of GenAI tools for game development have been identified by researchers as *context-dependent*. For one, the usefulness of GenAI tools differs significantly between *artistic* and *technical work-related processes*. Research has consistently shown that the introduction of GenAI has made life easier for programmers. The acceptance of GenAI tools for programming is high [3], using tools such as GitHub Copilot [15] that contain features like providing auto-complete code suggestions. These tools improve both efficiency and quality of their work. Additionally, a recent study on general attitudes of game industry artists found that people performing exclusively artistic tasks were least favorable toward GenAI tools compared to employees with no artistic (e.g., technical or managerial tasks) or mixed (i.e., both artistic and non-artistic) tasks [19]. Programmers use GenAI tools primarily to solve specific work-related problems, such as coding issues, which are generally less personal compared to the creative expressions that are embedded into an artist's work [3]. A second contextual factor is the *specific development stage* at which GenAI tools prove most useful. As previously mentioned, developers perceive GenAI tools as real game changers during the pre-production or early stages of game development, but less applicable for use in the final production phases [2][3]. Indie developers mentioned, for instance, that such tools can facilitate ideas by jumpstarting the game development process [5]. Image generation tools specifically are often mentioned for early development as they amplify artists' visions for the game, enabling them to visualize their creative thoughts to other team members (often non-artists) without losing them in verbal communication (i.e., visual communication [20]). The final contextual factor to consider here relates to the usefulness of GenAI tools for *specific types of content* and *specific GenAI tools* themselves. For instance, developers mentioned that GenAI tools can be beneficial to create more general artwork, but are less relevant to generate specific assets for a game, as these often show poor quality and inconsistency in terms of artistic style [3][6]. Furthermore, developers seem more open to use GenAI tools that have been trained on open source or voluntarily-provided data (e.g., Adobe Firefly [21]) without having the risk of running into copyright issues [3]. They are also more open to specialized tools that enhance developers' skills and improve their workflow by assisting them with, for instance, in-line coding suggestions (e.g., GitHub Copilot [15]), rather than using broader conversational agents like ChatGPT [22].

2.2. Weaknesses and Risks of Generative AI for Game Development

While some consider GenAI to be the biggest innovation driver in the gaming industry since virtual and augmented reality technology [23], it's not only (GenAI-generated) sunshine and rainbows. There are at least four major downsides and potential risks to consider regarding GenAI-powered game design. First, there are some general concerns regarding GenAI's *environmental impact*, as these large language models (LLMs) require tremendous amounts of computational power in energy-consuming servers [24]. Given the ongoing debates about making the gaming industry more 'green' [25], the growing reliance on GenAI tools could pose potential ecological concerns [26].

Second, the creation of game narratives, characters, dialogues and entire game worlds through GenAI tools leads to several *ethical concerns*. One of the main challenges that developers identified are the potential copyright issues that accompany the usage of GenAI tools [3]. Image generation tools such as Midjourney [12] are not (only) trained on open-source artwork but use existing data from artists who are most likely not compensated for the use of their creative work through such tools. This artwork is protected by copyright, which makes it risky for other artists to use GenAI tools that likely produce output based on copyrighted material. Sikorski et al. [19] mentioned that one working point to create a smoother transition for GenAI tools into the game industry is to clarify this copyright issue. This ethical concern is not just about avoiding lawsuits and prosecution.

Especially early career developers have a sense of ethical commitment to fellow game developers and artists, as GenAI-based image generation could damage the future of their profession [3] (more on this below). Additionally, these ethical concerns are not only focused at others' work: according to current legislation (e.g., U.S. laws), GenAI-generated content cannot be copyrighted itself as because it doesn't originate from a human author [5]. This leaves content and potentially entire games created by developers that used GenAI tools without any legal protection and free to use by other people.

Third, *career concerns* relate to the consistent fear that increased usage of GenAI tools will eventually lead to less employment opportunities among voice actors, writers, visual artists, and even game developers [27]. A recent survey among game developers at the Game Developers Conference [4] confirms these concerns, as the results revealed that a large majority (84%) of developers indicated being quite concerned about the employment and ethical implications of GenAI in the gaming industry. Academic research discovered similar career growth challenges, as developers express concerns about losing their jobs or livelihood [6]. Some expressed these concerns more specifically in relation to game artists, noting that the reuse of artistic assets (or standardized templates for generating them) could reduce the demand for human artists [5][19]. Job loss is not the only career-related concern here. The introduction of GenAI tools is also directly responsible for the transformation of game developers' job descriptions [6]. Their roles tend to shift responsibility, going from a creator to a director or editor to the GenAI tools, which some developers indicate is a weakness of these tools as they feel somewhat demoted compared to their previous functioning.

This fear of employment loss (and transformation) exists despite the notion that GenAI tools are, at least at this moment, not *there* yet. For one, they still need human input to create assets, coding or artwork. GenAI is not able to "replace the essential human creativity, imagination and artistry that goes into developing new video games" (para. 8) [8] just yet. Furthermore, they still produce many errors and overall lack basic quality as well as efficiency within existing workflows. These aspects can be considered as the fourth main risk factor for GenAI's integration in game development: *practical concerns*. Perhaps the most often mentioned concern here is the lack of consistency when creating artwork through GenAI tools [3]. Disbarring any recent evolutions in GenAI's 'memory' acquisition [28], GenAI tools are currently unable to maintain consistency in terms of idea generation and artistic style [6], something that is essential when generating artistic assets or storylines that need to adhere to the defined visual or narrative style of the game [5]. Besides inconsistency, mostly game artists identified that, through current interfaces of GenAI tools, they had a hard time finding the right words or 'prompts' to convey certain emotions into generated images [3], as artists are accustomed to work with other modalities such as visuals or the spoken word [6]. This is not just a concern for image generation. Developers also mentioned this as a weakness for game writers, given that GenAI tools often offer a more verbose or literal way of textual or spoken dialogue for a game's narrative that differs significantly from more natural, human dialogue [3]. Another practical concern relates to the efficient integration of GenAI tools in game developers' workflows. Again, especially artists were concerned with this, as some argued that it took them longer to use prompts through GenAI tools like Midjourney [12] to get it exactly right than to just draw the artwork themselves. In addition, artists often work with multiple layers for in-game animations and require specific resolution values that most GenAI tools cannot provide at the moment. A final practical weakness concerns the authenticity of storytelling and NPCs created by Gen AI. As these tools are trained on existing data, chances exist that using them extensively in game design will create more repetitive and less original, innovative, and creative games in the long run [26].

Overall, these weaknesses and risks surrounding the usage of GenAI tools for game development concern developers, preventing them from implementing these tools in their daily workflow. A clear example of this comes from Boucher et al. [3], who found that a majority of interviewed student developers "were skeptical of the claimed benefits of using GAI in their workflows, and that many even refused to use GAI tools for any part of the development process despite repeated encouragement from the program director" (p. 5). It is clear that developers' perceptions and

adoption rates vary significantly, and that more research is needed to understand the complex relationships between game developers and GenAI tools.

3. Present Study

Existing literature on generative AI for game development revealed that developers see the most opportunities for the integration of GenAI tools in early game development and for technical tasks (i.e., coding, programming [3]), while especially game artists occupied with creating visual components for a game are more inclined to have ethical (i.e., copyright, IP) and practical concerns (i.e., lack of quality, consistency, and efficiency [19]). There is little to nothing known regarding the attitudes toward and use of GenAI tools for other parts of the game development process, such as game writing and narrative design, audio and voice design, and game marketing.

The few studies that have focused on game developers' perception and use of GenAI either focused on specific target groups—student and early career developers [3] or non-profit driven indie developers [5]—or on specific GenAI tools, like image generation applications [6]. To support game developers with this increasingly present technology and create actionable guidelines on how GenAI tools can be integrated in game development processes in effective and ethical ways, more research is required to provide detailed insights into how established and upcoming industry professionals perceive and use GenAI tools for game development. Similar to prior work focusing on the Finnish [6] and Polish [19] gaming industry, this paper takes a case study approach by zooming in on the Belgian game industry. This industry is especially relevant, given that it includes a broad range of game studios, from innovative start-ups and established indie game studios to internationally acclaimed studios [29]. As such, we questioned these developers regarding their perception toward (i.e., strengths, weaknesses) and use of (i.e., opportunities, risks) GenAI tools for game development. This leads to the following two main research questions:

RQ1: Which strengths and opportunities do Belgian game developers identify regarding the use of GenAI tools for game development?

RQ2: Which weaknesses and risks/concerns do Belgian game developers identify regarding the use of GenAI tools for game development?

4. Methods

This study employs a qualitative research design to examine how game developers in the Belgian game industry perceive and use generative AI. Data were collected through in-depth interviews, with a semi-structured questionnaire allowing for consistency and flexibility across respondents [30]. Compared to quantitative approaches, this qualitative approach allowed for a much deeper and more detailed underlying reasoning from the industry on how they perceive and use GenAI for game development.

4.1. Procedure

Before data collection started, respondents received an informed consent form briefing them regarding the use of audio recording during the interview, assurances of confidentiality and anonymity of the interview, and their right to withdraw from the study at any given time.

The interviews were part of a larger project focused on the intentions, strategies and techniques game developers have and use to evoke eudaimonic player experiences (EUPX), or experiences that foster personal growth and help players realize their full human potential [31], which includes emotionally moving, (self-)reflective, and socially connecting player experiences [32]. Besides asking about their eudaimonic intentions and development strategies, the interviews also inquired about recent innovations and technological advancements in the game industry, such as generative AI. Questions for this particular topic related to the use of GenAI in general and toward the design of games that provoke EUPX in particular.

4.2. Sample

Respondents were recruited using a combination of convenience sampling (i.e., through the author's personal network of game developers) and snowball sampling (i.e., recruiting developers from the network of respondents that were already recruited). The sample of this study consisted of 20 Belgian game developers. 16 men, two women and two non-binary people were interviewed, with a mean age of 32 and an average 5.65 years of experience in the gaming industry. The study included both established members in the Belgian game industry and six game design students, interns, or developers who just started their first game (studio). Further diversification was made in the different functions someone can have within a game studio, including CEO's, founders, or game directors; artists and creative or art directors; programmers or tools developers; writers/scripters working on the narrative; and sound designers. An overview of the respondents' background can be found in Table 1 (Appendix A).

4.3. Analysis

The interviews were transcribed verbatim and coded through NVivo 1.7.2. [33] to organize, structure and analyze the interview transcripts. Following a thematic analysis approach [34], the transcripts were first coded openly and inductively—codes were derived from the data itself—to structure and reduce the data into clear text codes. Conceptually similar codes were then put into overarching codes or themes, merging codes when they were conceptually identical. After reviewing and renaming these themes, the final phase of analysis included connecting the identified themes associated with GenAI to the posed research questions and reporting the findings in the next section.

5. Results

The thematic analysis resulted into two smaller themes (i.e., 'GenAI and emotion/eudaimonia' and 'Specific cases and examples of GenAI use') and three major themes: 'General attitudes toward GenAI,' 'Advantages and uses of GenAI,' and 'Weaknesses of and concerns toward GenAI'. These larger themes can be further broken down into 16 subthemes, with three subthemes discussing general attitudes (e.g., 'GenAI promising evolution' and 'Against AI use'), eight subthemes addressing strengths and opportunities (e.g., 'AI images,' 'AI for executive/technical tasks' and 'AI as supporting tool'), and five subthemes addressing concerns and risks (e.g., 'Concerns about quality GenAI' and 'Concerns about employment'). Since this paper does not specifically focus on the emotional and eudaimonic potential of integrating GenAI into game development processes, and the results section will provide concrete examples of how respondents use GenAI tools, we will concentrate on the three main themes and their corresponding subthemes.

5.1. General Attitudes Toward Generative AI for Game Development

The first theme gathers developers' overall attitudes toward GenAI for game development. Some were quite positive about this, calling it "*the big trend*" of game development (Intw. 12). Others were cautiously optimistic. One respondent mentioned that it is "*complicated too because, as an artist,* [generative] *AI is a subject that's on everyone's lips. But I'm not 100% against* [generative] *AI, to be honest, like it can help in some ways*" (Intw. 18). Another developer stated that, while he currently did not use GenAI that much, he suspected that it is something to keep an eye out for in the future: "*I'm almost certain that with* [generative] *AI, if that is worked out a little more, that that* [providing game designers with more options to do something cool] *can be done*" (Intw. 11). Yet others were more neutral toward GenAI, as they were not yet convinced of its potential:

> "*We are at the beginning of* [generative] *AI. So, who knows what's out there in five years of ten years, but right now, I don't see the added value yet for our sector, our industry.*" (Intw. 1)

However, and perhaps surprisingly, most voices regarding GenAI tools were rather skeptical or downright negative of their inclusion in game development processes. Some mention the context-specific strength of GenAI tools: "*There are certainly useful things about it, but in the creative aspects I am more of a humanist*" (Intw. 13). Others repeated concerns connected to employment risks—"*We say no, sorry, we cannot do that because that was done with generative AI and we are now taking work away from graphic designers and illustrators*" (Intw. 10)—and yet others mentioned more quality-related concerns of GenAI as creating less original and creative content: "*You also see that there are many games that lose a lot of heart and passion because they start using* [generative] *AI a lot*" (Intw. 3). One respondent voiced a clear negative attitude toward GenAI tools, based on ethical concerns regarding copyright issues:

> "*I am very, very, very, very hard against it. Generative AI is one of the worst inventions of the last 50 years. (…) Actually making something from scratch based on a prompt (…). Yes, that is just theft. That is theft."* (Intw. 9)

5.2. Strengths and Opportunities of Generative AI for Game Development

In this second theme, developers' perceived strengths and identified opportunities surrounding the use of GenAI can be divided into two major categories: strengths and opportunities that relate to specific game elements or stages of the development process, and more overarching opportunities for the game development process as a whole.

In terms of specific strengths, some respondents mentioned they used GenAI tools to draw **inspiration for their game**, for example, when needing to come up with **names** for certain elements within their game. For their factory automation game, one developer used GenAI to ask "*Now give me 200 names for* [factories]. *(…) The titles of our factories, you can still have AI extract* [those] *now*" (Intw. 1). Another respondent mentioned a similar use of GenAI tools:

> "*Names of places are tricky. So, coming up with place names that are truly unique, some people give* (…) *Then you give a description of your area and then ChatGPT* [gives you] *a list of names that you can then either continue to create from, namely by linking that list together, or by just using one of them.*" (Intw. 16)

Next to name giving as a use for GenAI tools, one respondent (Intw. 16) mentioned that he knew a game company that used **GenAI-generated art** for the background images (e.g., a city, village, or forest) of certain cards designed for a board game. However, he was one of the few developers to be convinced of GenAI's usefulness to create game environments and other artwork: "*Yes, if it's really an abstract background. Usually there's more to it. There are different layers work together*" (Intw. 6), signaling the complexity of working with GenAI tools as (environment or character) artists for games. This sentiment reflects the strong consensus among the interviewed developers that GenAI tools hold **greater potential for supporting executive and technical tasks** in the development process, rather than creative ones. Providing aid with programming and coding tasks is the number one strength developers mentioned: "*For a coding problem, if there's something where we totally do not know how to get started on that, it's helpful for getting a synopsis or something like that. Or a place to start looking*" (Intw. 11). One respondent (Intw. 17) mentioned using ChatGPT as a tool to create games, which he argued sometimes helped him with coding tasks, but no other tools were specifically mentioned. Furthermore, the argument of GenAI tools being able to speed up some processes was made by another respondent: "*if it's to speed up some processes, making things easier for everyone, make the* [generative] *AI conduct some tasks that are not fun at all. That's important*" (Intw. 18).

Another subtheme that several respondents addressed is the impact of GenAI on a game's **narrative** and **players' agency** within both that narrative and the larger game world. Some respondents saw the potential of this, stating that integrating games with LLMs can create "*a sort of player freedom,* (…) *there's a fascinating side to that*" (Intw. 3) and offer a more dynamic experience where players can provide input. This is, however, still in a hypothetical stage, as none of the respondents mentioned they were working on such a game project. They rather talked about this as a future opportunity for game developers: "[Generative] *AI could possibly take over parts of the game.*

Games could become bigger, and could also become more reactive" (Intw. 14). Another respondent talked about this more in detail:

> "*The big trend of course is* [generative] *AI. (…) By being able to better track what your player is doing, you will also be able to respond to that player better and actually craft a very unique path for your player.* (…) *What everyone is now full of a Baldur's Gate or a Kingdom Deliverance, where you can make so many choices, have so much agency. That will only grow exponentially in the future. That agency. And then especially in the narrative."* (Intw. 12)

As a final specific strength, some respondents mentioned that **audio** elements in games could also benefit from the integration of GenAI tools. However, similar to the narrative elements, they rather see this as a future innovation than something that is already happening right now. One respondent further reflected on this: "*you feel that you* [can] *have a smart audio system that allows you to adjust your audio to what you want your players to feel. Then, you can go very deep in terms of emotion*" (Intw. 12).

Switching gears to more overarching opportunities developers perceived, the biggest argument a lot of the interviewees mentioned was that GenAI tools are very **useful during early development stages**. Several developers mentioned they use GenAI tools to "*get some quick ideas without having to spend too much time*" (Intw. 19). Using these tools in the concept phase, for instance, to visualize your thoughts and present them to other members of the development team, is frequently mentioned: "*Conceptually, if you're really thinking about having a concept that you can give to an artist. This is kind of a mood board. This is something we want to create. For that mood board, you can use AI-generated images*" (Intw. 6). Next to using these tools for **mood boards** and **conceptual art**, students game design also used GenAI to draw inspiration from, as one respondent mentioned:

> "*They use AI images to get inspiration for their projects. They had to create a murderer, for example,* (…) *for a certain course. They listed a series of murderers* [using GenAI]. (…) *And then used those images to draw a new design in their sketchbook.*" (Intw. 16)

Another example besides GenAI-generated images comes from a developer who uses **GenAI-generated voice lines** in game prototypes: "*if you start using those AI voices yourself to quickly put something together, so prototyping,* (…) *I also use those AI voices myself sometimes. And that's okay, as long as it's not in the final result*" (Intw. 8). The final part of this developer's response is the main reason why the interviewed developers view GenAI tools are more useful in early development stages: many of them report on ethical concerns of just copy-pasting GenAI-generated content into their games, or discuss concerns regarding copyright issues for their final gaming products (more on this in the next section).

Related to the notion that GenAI tools have a bigger role to play for programmers and executive roles in game development, respondents that had a neutral or positive attitude toward GenAI tools perceived such tools as more **supportive, rather than creative, instruments**. One respondent described it as this: "[Generative] *AI helps.* (…) *You have to use it to help your creations, not to create*" (Intw. 15). Interestingly, another developer mentioned that he predicts that the introduction of GenAI tools will be "*more important for production-oriented changes than for changes in games*" (Intw. 14), suggesting that GenAI will have a greater impact on how games are developed than on the games' actual content.

Finally, only one respondent mentioned the potential strength of GenAI tools for **indie game developers** specifically: "[Generative] *AI is still viewed very negatively at the moment, but I think it could be a good thing for indie companies to shoot above their ballpark*" (Intw. 11).

5.3. Weaknesses of and Concerns Toward Generative AI for Game Development

This third theme represents the weaknesses and concerns associated with the integration of GenAI into game design. Five subthemes were found that discuss concerns about quality of GenAI-generated output, risks regarding employment, copyright and other ethical concerns, and experiencing a lack of control with GenAI-generated content.

The biggest weakness that developers encountered was the **lack of quality** of current GenAI tools. These quality concerns exist for multiple roles within game studios—narrative designers, game artists, and even game programmers. One respondent mentioned that, when trying to develop more story-driven games with GenAI tools such as ChatGPT, "*it's relatively difficult to tame* [generative] *AI. Because they want to go very broad and don't always have the right intentions when generating dialogue or storylines*" (Intw. 17). GenAI tools are not just hard to 'steer' when trying to create storylines or dialogues. They also provide text that is easy to identify as being GenAI-generated, due to the perceived lack of storytelling quality:

> "*While I understand that a game dev, who is not much concerned with story and has a nice idea for his gameplay, will ask ChatGPT: 'What are nice environments or stories that I can tell?'* (…) *But I personally find those answers so trite. I have tried it a few times, when I am in a kind of brainstorming kind of way… Give me ten funny wordplays* (…) *and they are all so bad.* (…) *It's really just a search for banalities. A search for mediocrity.*" (Intw. 9)

Another respondent mentioned that GenAI tools are "*still a bit annoying to use, for example, for image generation. It's just faster if we do it ourselves*" (Intw. 11). Surprisingly, while GenAI was perceived as a positive innovation for coding and programming tasks, several respondents suggested that such tools can also have a negative impact on this type of labor: "*for coding, it can sometimes help, but it can also sometimes be a very junior programmer and introduce sneaky bugs*" (Intw. 17). Another developer connected this specifically to creating emotional experiences and losing control when trying to program such experiences using GenAI: "*I rather stick to 'human' programming. Yes, it can go faster* [for] *programming. But I think if you really want to evoke specific emotions, you* [can] *lose some of that control*" (Intw. 7).

Aside from quality concerns, the second most frequently mentioned risk among the interviewed developers was the potential threat of **employment loss** associated with the (mass) introduction of GenAI in game development processes. One respondent had a clear argument regarding this concern:

> "*It shouldn't be at the expense of jobs* (…). *I think it's a shame that studios, mainly the larger ones, commit to* [generative] *AI models based on the work of their employees. So, suppose you are a good programmer or a good artist. You work for a large company.* (…) *And at the same time, there is an* [generative] *AI model behind the scenes that learns from that. And then a quarter of a year later, the company says 'Yes guys, you did a good job, but I'm going to have to fire you.' Because, in the meantime, we have created two* [generative] *AI models that can completely replace you. That is a trend, for example. I am very afraid of that.*" (Intw. 8)

Finally, several less frequently mentioned concerns relate to **copyright** and **broader ethical** risks, as well as experiencing a **lack of control** over GenAI-generated output. One respondent mentioned that GenAI-generated content cannot be included "*into production, because then there are copyright issues. So, we're not going to use that in production*" (Intw. 1). Another developer shared his experience using GenAI tools to create mock-ups with AI-generated images. Although the client liked these exact mock-ups, the developer had to say that these exact images couldn't be used as they were generated with GenAI, taking away employment from illustrators and graphic designers. He emphasized that these are ethical or deontological considerations each developer must take into account, given the lack of control over copyright and intellectual property. The final concern comes from a developer who mentioned that "*people who are starting to use* [and interact with generative] *AI, they have them say and do certain things, giving them completely different meanings* [from what developers intended]. *That they start to become very inappropriate*" (Intw. 7), suggesting that the introduction of GenAI tools, especially in character design, might lead to a lack of control from a developer's standpoint over how players interact with such GenAI-powered NPCs.

6. Discussion

The current paper's objective was to provide a first, exploratory overview of how Belgian game developers perceive and use generative AI in their daily game development. As prior research

focused only on student game developers [3] or on specific GenAI tools [6], this study included both established and student game developers with a broad range of functions—from CEO's to artists, programmers, and narrative designers—with no restrictions toward specific types of GenAI tools.

In terms of general attitude toward GenAI's integration in game development, a variety of opinions existed, going from positive to downright critical attitudes. Most respondents, both established developers and newcomers alike, were rather skeptical toward GenAI's usefulness, voicing clear concerns about the technology's impact on quality, employment, and intellectual property. These findings are not surprising, as they confirm earlier results among student developers [3]. This implies that game developers, even more experienced ones, remain critical toward GenAI. However, some developers expressed cautious optimism about the technology's future and its potential benefits. According to them, it is still too early to draw any definitive conclusions about the strengths and opportunities of GenAI.

6.1. Perceived Strengths and Opportunities of GenAI for Game Development

The identified strengths and opportunities of GenAI bare some similarities with prior work. For one, developers showed a strong consensus toward the notion that GenAI tools are particularly useful for technical tasks such as programming or coding over creative and artistic tasks [3]. Helping out with coding issues or speeding up programming was the number one strength for many developers.

Another interesting finding was that most of the current use of GenAI tools occurs during early stages of game development, like gaining inspiration from ChatGPT [22] to give original names to buildings or areas within the game, creating GenAI-generated artwork for mood boards, or use GenAI-generated voices in early game prototypes. Using GenAI tools to jumpstart the development process is an application of these tools that is also mentioned in prior work [2][3][5][6], as they provide inspiration and exploration possibilities [20]. As such, GenAI tools' integration in the actual development stages has not (yet) been a priority for game developers. While there is the strong argument that the quality of these tools are not yet on par with existing non-GenAI game development tools [8] (see also the developers' concerns), another possible explanation could be that, given the very recent emergence of GenAI in game development, most developers are not yet familiar and/or trained sufficiently to work with these tools (see Implications). This speculative explanation is strengthened by the finding that most opportunities the interviewed developers identified, for instance regarding smart or dynamic audio and narrative systems that reacts to unexpected player inputs [1][8], are still ideas for the future, not actual use cases in their current game development processes.

6.2. Perceived Weaknesses and Concerns of GenAI for Game Development

Regarding the weaknesses and concerns developers have about GenAI tools, the subthemes that were identified in this study were fairly similar compared to the concerns mentioned in previous work [3][4][5][6][19]— ethical concerns regarding copyright and intellectual property, career and employment concerns, and practical concerns regarding, for example, the output quality of these tools. Perhaps interestingly is that, compared to the other two main concerns, the interviewed developers in this study were less occupied with ethical concerns regarding copyright issues. Only three respondents briefly mentioned these concerns of being at risk of copyright infringements when using AI-generated content.

Furthermore, career-related concerns were exclusively focused on the loss of employment by fellow developers and artists, similar to prior research [4][6]. One respondent made a clear argument that (creative) assets originating from human employees can be used to train GenAI models, potentially making these artists obsolete in the future [5][19]. While this Belgian developer was providing a hypothetical example, real-world cases—such as the recent layoffs at gaming studio King, where level designers and copywriters reportedly lost their jobs after training AI tools meant to support their workflows but now poised to replace them [35]—show a very concerning trend in the gaming industry. However, none of the respondents discussed any career-related concerns beyond

employment loss, contrary to prior work indicated that GenAI tools can also transform in developers' job descriptions and responsibilities [6].

Finally, the main concern or weakness discerned about GenAI tools was their outputs' lack of quality, mentioned by artists, writers, and even programmers. While prior research showed that mostly artists find the lack of quality disturbing [3], only some respondents mentioned this as a weakness of current GenAI tools. Similarly, concerns about the quality for storytelling made in the current study—GenAI-generated narratives that are trite and just mediocre—resonate with prior work regarding the negative impact of GenAI on authenticity of storytelling [26]. Contrary to prior work though, this study also found that some programmers have concerns regarding the quality of GenAI tools for their coding work. This could be explained by the notion that these respondents used more 'general' GenAI tools, such as ChatGPT [22], compared to more coding-specific tools, like GitHub Copilot [15].

There are two final findings of this study worth mentioning. First, the environmental impact of using GenAI was not a concern at all for the interviewed developers: sustainability was only briefly mentioned by one respondent. Second, concerns about developers' lack of control over how players interact with NPCs powered by LLMs—potentially leading to inappropriate situations—have not, to my knowledge, been addressed in prior research. This last finding deserves additional investigation in future research.

6.3. Cross-National Comparison on GenAI for Game Development

Prior research by Vimpari et al. [6] and Sikorski et al. [19] offered insight into how game industry students and professionals from Finland and Poland, respectively, perceive and adopt GenAI tools, similar to our case study of the Belgian game industry.

Common themes across these industries include a general concern regarding employment loss due to the increasing integration of GenAI tools in game development workflows, which has also been identified as a global concern [4], and GenAI tools' potential to support game developers, especially in early development stages for exploration and inspiration purposes. Both the Polish and Belgian game developers, for example, agreed that, at this stage of GenAI's capabilities, these tools are more beneficial for coding and pre-production tasks than for artistic work during production. Furthermore, the Finnish and Belgian developers raised concerns about the quality and consistency of GenAI output, not just for image generation [3][6], but also for storytelling [26] and even coding tasks—issues that have also been observed in software development outside the gaming industry [18].

Interestingly, while the Finnish and Polish game developers were generally more positive towards GenAI tools—perceiving text-to-image-generating (TTIG) systems like DALL-E or Midjourney as interesting and impressive [6], or developers not occupied with creative or artistic tasks assessing GenAI tools as useful [19]—Belgian developers overall adopted a more skeptical attitude toward GenAI. Given the small-scale, exploratory nature of these studies, especially the current one ($N = 20$) and the Finnish study ($N = 14$), this discrepancy may not be representative of the broader Belgian or Finnish game industries (see also *Limitations and Implications*). A second difference was found in how developers have ethical concerns: while half of the Finnish developers mentioned ethical concerns related to copyright issues and intellectual property when using TTIG tools [6], the Polish and Belgian developers did not state ethical concerns as being important. This difference may be explained by the Finnish study's exclusive focus on image generation tools, whereas the other two studies examined GenAI tools more broadly.

6.4. Limitations and Implications

The current study has several limitations to take into account when interpreting the findings. First, the choice to use a qualitative research design led to less generalizable findings. Despite respondents providing detailed and personalized insights into their attitudes toward and experiences with GenAI tools, the small sample size in this qualitative study is not necessarily representative of the Belgian

game industry. As such, this study does not allow for generalizable conclusions, especially not for the global gaming industry, where varying contexts and levels of GenAI integration across regions may lead to different outcomes. Therefore, I would recommend future research on this topic to focus on conducting a large-scale survey of game developers, focusing on the Belgian industry or an a more international developer population. Such an endeavor could also compliment the current study's bottom-up approach by building on existing theoretical frameworks, such as the Unified Theory of Acceptance and Use of Technology (UTAUT)[36]—a framework previously used to study the adoption of AI tools in other contexts [37] and which includes factors like performance and effort expectations, and social influences—to broaden explanatory factors regarding developers' willingness to integrate GenAI in game development.

A second limitation relates to the exploratory nature of this study. Being part of a larger project on emotional or eudaimonic player experiences, examining the perceptions and usage of GenAI tools in developers' practices was not the main focus of the interviews. This could explain why developers, for instance, did not mention the use of specific GenAI tools besides ChatGPT [22] as frequently as in previous work on this topic: we simply did not ask them to reflect that deeply on this topic. Similarly, the interview data lacked any clear findings about the use of GenAI for audio design or game marketing. While this may reflect a genuine absence of the use of such tools for these purposes, it could also be a result of the study's exploratory setup. Building on this and previous research, future studies should therefore start with a clear focus on finding the strengths, weaknesses, opportunities and threats or risks accompanying GenAI integration in game development, for example, through a practice-based perspective like a SWOT analysis.

Additionally, future research should examine how GenAI tools, which increasingly offer automation benefits, affect not only the creation of artistic games— understood as games with experimental or unconventional narratives, mechanics, and aesthetics [38] that offer meaningful societal critique and novel storytelling [39]— but also how GenAI-powered game design affects players' experiences, such as eudaimonia [32]. This research would address the existing tension between GenAI's capacity for development automation and the potential risk of diminishing the originality of and creative expression in artistic games. In doing so, such an approach can provide valuable insights for game developers, emphasizing a critical and careful approach to leverage its potential for economic competitiveness while safeguarding creative and artistic expression.

An important implication of the current study is that some identified weaknesses and concerns could be decreased when game developers are properly trained to work with GenAI tools in the context of designing games [19]. While the introduction of GenAI for game development has been met with initial fears of employment reduction [4], these tools still need human input. It is therefore very important to educate game design students and additionally train established game developers to provide them with the necessary skills in order to stay competitive [16]. This could include developing prompt engineering skills to use in automatizing several game development stages, such as the conceptual phase (artwork, scenario's, scripts), initial game engine coding, but also using GenAI to aid in the marketing and business side of game development. This training would create a better understanding of GenAI tools' inner workings and their potential opportunities, but would also improve developers' awareness and criticism of their downsides—building toward more AI literacy skills. "Knowing when, where and how to use AI, (…) prioritizing which tasks can be offloaded to an AI to reduce cognitive debt is just as important as understanding which tasks require genuine creativity and critical thinking." (para. 26) [40] are additional AI literacy-related skills relevant for game developers to acquire.

7. Conclusion

This exploratory qualitative study provides early insights into how generative AI affects game development in the Belgian gaming industry, revealing how developers perceive GenAI's advantages and pitfalls, and how they currently use it in their development practices. Regarding general attitude,

some developers expressed cautious optimism about GenAI's potential, while most remained skeptical of its current practical value. GenAI's strengths were seen in coding and other technical tasks rather than in creative work. Its opportunities lie mostly in early development stages—for instance, for generating names of in-game objects or creating images for concept art and mood boards. Quality concerns surfaced most often: Belgian developers criticized GenAI for mediocre storytelling, inefficient image generation, and buggy coding outputs. Worries about job displacement were also persistent, whereas ethical issues like copyright and IP infringement were mentioned less frequently.

These findings are relevant for several actors, including game developers, educators, policymakers, and researchers. They can inform discussions within the game developer community, advise policymakers in providing much needed legislation surrounding the boundaries of GenAI (and, for instance, clarifying copyright issues [19]), and may boost future research that contributes to a better understanding of how GenAI can be integrated in a supportive rather than harmful way in game development.

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Declaration on Generative AI

During the preparation of this paper, the author used GPT-3.5 and Gemini 2.5 Flash for grammar and spelling check, never to generate new sentences, arguments, or academic sources. After using these tools, the author critically reviewed and edited the generated content as needed, taking full responsibility for the paper's final content.

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Appendix A

Table 1
Overview of Sample Characteristics

Interview	Gender	Age	Years experience	Function
Intw. 1	Male	45	11	CEO / Founder
Intw. 2	Male	37	1.5	Game Director
Intw. 3	Male	29	10	CEO / Founder / Game Developer
Intw. 4	Non-binary	32	0	Artist / Creative Director / Game Director
Intw. 5	Male	49	23	CEO / Co-Founder / Product Designer / Game programmer
Intw. 6	Male	23	0	Student Intern (Game programmer)
Intw. 7	Male	23	0	Student Intern (Game programmer)
Intw. 8	Male	27	2	Founder / Game Developer / Narrative Designer
Intw. 9	Non-binary	39	4	CEO / Game Developer
Intw. 10	Male	NA	2.5	Game Developer
Intw. 11	Male	22	1	Game Developer / Programmer
Intw. 12	Female	43	10	Game Developer
Intw. 13	Male	37	10	Game Writer / Scripter
Intw. 14	Male	31	10	Game Programmer / Audiovisual and Narrative Tools Developer
Intw. 15	Male	20	0	Student Game Design
Intw. 16	Male	23	0	Student Game Design
Intw. 17	Male	30	0	Game Developer
Intw. 18	Female	32	8	Art Director / Animator
Intw. 19	Male	46	16	Founder / CEO / Game Designer
Intw. 20	Male	27	4	Game Programmer / Tool Developer / Sound Designer