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Applications, Risks, and Future Prospects of Artificial Intelligence in Game Design--From Commercial Game Development to Serious Games

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Abstract. Nowadays, artificial intelligence (AI) no longer merely plays traditional roles in behavioral control, procedural generation, and data analysis in the game industry. It has become a production tool capable of generating images, code, and other interactive content. It allows game studios to shorten the time cost in development and lower the cost of prototype production. It also allows their games to deliver personalized player experiences. At the same time, AI also raises many concerns about copyright ownership and job displacement. Based on GDC surveys from the past three years, this paper first explores the current applications of AI in game industry and the controversies about its use. It then discusses several new directions of future applications, such as intelligent NPCs, dynamic storytelling, and personalized experiences. Finally, this paper explores the social value and ethical boundaries of AI in serious games related to social issues. This paper argues that the most appropriate role of AI in the game industry is not to replace game designers, but to play as a tool governed by design goals and clear accountability mechanisms. Only by maintaining a balance among efficiency, creativity, and transparency can AI truly improve the quality of game design.

Keywords: Artificial intelligence, Game design, Serious games, Ethical risk

1. Introduction

In recent years, AI, especially generative AI, has become one of the most promising and controversial technologies in the game industry. Generative AI refers to tools that generate images, audio, or code.

The Game Developers Conference (GDC) State of the Game Industry surveys from the past three years showed that attitudes toward generative AI within the industry are becoming more divided. In the 2024 survey, approximately four-fifths of developers showed concerns about the ethical impact of generative AI [1]. As shown in the 2025 survey, about one-third of developers reported that they are using related tools in their work, while 30% of respondents believed that generative AI was having a negative influence on the game industry [2]. By 2026, the adoption rate remained at about 36%, but the proportion of industry professionals holding negative opinions had increased to 52% [3]. The 2026 data also showed that the adoption rate among professionals working in business,

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publishing, and marketing was significantly higher than that among those working in art, narrative, and programming-roles more directly involved in content production .

These findings show that AI has already become part of game development. However, it is not widely accepted by the game industry.

The preceding discussion shows that the core question is not whether AI should be used in games, but how it should be used. Therefore, this paper examines the issue from three perspectives: commercial game development, the design of future game systems, and serious non-commercial games. And I would advance a central argument: the primary value of AI in the game industry is helping designers turn their ideas into real work, instead of replacing human creativity or transferring professional responsibility to machines.

2. Current applications and risks in game development

2.1. Improving efficiency in the production process

Game development needs lots of departments to collaborate. Through the production process, these departments need to communicate, modify, and evaluate their work repeatedly. As a result, a considerable amount of time is spent on communication and other non-creative tasks instead of creating the content. AI can help game development teams complete these tasks and produce content more efficiently. For example, programmers can use AI tools to interpret error messages and organize test cases. Game designers can also use AI to quickly build gameplay prototypes and determine whether their ideas are fun or not.

This kind of assistance can be of great help to indie game studios. Creators with limited resources are often unable to maintain complete art, programming, and marketing teams at the same time. AI can help them produce prototypes, placeholder assets, and basic data analysis more quickly, which allows them to focus their limited budgets on developing core mechanics and evaluating the player experience. However, AI-generated content still requires clear requirements, aesthetic judgment, and technical verification. Without these forms of human involvement, AI may increase the amount of content produced and accelerate the production process, but it is unlikely to improve the quality of the final work.

Overall, the most immediate role of AI in today's game industry is to improve production efficiency. Nevertheless, the content it produces must still be reviewed, evaluated, and refined by the development team.

2.2. Creative quality, authorship, and labor structures

Game design is the process of building systems around an intended player experience. As generative AI can copy some designs in existing games, it is not able to understand why a designer chooses a certain design for their games. Because the intended player experience varies, specific design decisions differ considerably across different games. In real world, even when designers draw inspiration from other games, they usually adapt those ideas to suit the needs of their own projects. If a development team relies too much on automatically generated content to lower their costs, the game will suffer from inconsistent styles, and excessive repetition.

This risk may also affect talent development within the industry. Nowadays, many entry-level employees become familiar with the full production process by completing basic and repeated tasks. If companies simply consider these positions as costs that can be replaced by AI, they may weaken the career path through which junior employees develop into experienced professionals over time.

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This means that AI may change the division of labor, but it should not be used only as a reason to ignore professional development or undervalue the contributions of human creators.

2.3. Copyright, transparency, and accountability

Another major risk related to AI concerns the legal relationship between training data and generated content. If an AI model is trained on those data without any authorization, commercial projects may encounter serious copyright risks, as illustrated by the recent controversy surrounding allegedly unauthorized art assets in *Marathon*.

For this reason, game studios need to establish practical and clear guidelines for the use of AI. First, development teams should document which models are used, their intended purposes, and the stages of production in which generated content is involved. Game developers should also review any AI-generated content that is included in the final product.

Second, human creators should also remain responsible for any creative work in the game development process such as character development and thematic expression.

Third, companies should protect the rights of employees and external creators, including their rights to attribution and control over how their work is used. Internal assets should not be used to train AI models without any permission.

Finally, when AI-generated content has a substantial effect on the player experience, developers should provide appropriate explanations. Though transparency cannot eliminate every risk, it is a necessary foundation for building trust between creators and players. Especially as live-service games become an increasingly important trend in the industry, game developers need to build strong mutual trust between creators and player communities.

3. Key areas for future AI exploration in the game industry

3.1. Procedural content generation and dynamic storytelling

Procedural content generation is not a new concept in the game industry. Many games have long used certain rules and random seeds to generate game content. But with the help of generative AI, I believe the way that game content is produced will have a big change. AI may shift it from combinations of preset rules toward variations based on meaning and gameplay context. In the future, games may generate new rumors, side quests, or environmental responses based on the player's previous actions. This could allow the game world to respond to player behavior in a more continuous way. In current game development, designers often spend tons of time creating a huge number of storylines and quests to make players feel that their choices can influence the game world. This approach greatly increases content production costs while still limiting the amount of content players can experience. With the help of AI, designers can provide a wider range of content more efficiently.

However, dynamic content does not mean unlimited generation. Game narratives still require consistent themes and clear cause-and-effect relationships. If a game system focuses only on producing variations as much as possible, it may generate some events that conflict with the current world or even disrupt the main storyline. A more practical workflow for game developers is for game designers to first establish character boundaries and other rules for AI and then allow AI to generate variations within these controlled limits. Finally, designers review their work during the playtests. In this workflow, AI expands the range of possible combinations, while human designers determine which content is meaningful and should be added to their game.

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3.2. Intelligent NPCs and under controlled generation

Traditional NPCs in video games usually rely on finite-state machines (FSM) and limited behavioral logic, which makes their patterns easy to recognize after repeated interactions with players, especially in action games. Future AI-driven NPCs may have more complex memories, states, and social relationships, allowing them to respond to players' natural-language input or combat behaviors. These developments could create new design possibilities for many game genres such as simulation games and role-playing games.

However, open-ended generation also introduces unpredictability. NPCs may create dialogue that does not fit their identity or historical setting. Thus, a real valuable AI-driven NPC should not function as a completely unrestricted chatbot, but as a controlled dynamic character.

Designers should also determine in advance how an NPC will return to prewritten dialogue or end the generated interaction when the model cannot provide a reliable response. This prevents a single inappropriate output from damaging the overall narrative experience.

All in all, intelligent NPCs and controlled content generation are good applications of AI, but they also place higher design demands on game designers and development teams.

3.3. Dynamic difficulty

Among the ideas studied in game design theory there is one called "flow." If the game's difficulty corresponds closely to the player's own skill level, then the player might enter a state called "flow", and this is one of the basic aims of good game design. Nevertheless, skill levels vary among individuals and so do their needs for challenge, which means that multiple fixed difficulties are often used by designers. However, such fixed settings leave room for failure: it is hard to guarantee that difficulty will fit all players' abilities. Some people improve rapidly with practice； others never seem to catch up. As a result, game designers today increasingly look at dynamic difficulty adjustment as an option. However, almost all current systems of dynamic difficulty still depend on prior rules-which do not fully adapt to every person.

However, AI has means of making more specific adjustments-based on gameplay data. In particular, one need not alter the basic rules of the game to vary enemy attacks, to change how resources come about, or to regulate hints given to the player. Thus it is possible to meet both needs: to explain the mechanics clearly and to keep the difficulty at a reasonable level for experts.

From this perspective, AI is likely to prove very useful for dynamic difficulty adjustment. By taking account of each player's actual skill, it becomes possible to allow many more players to encounter a difficulty level that is tailored for them.

4. The value of non-commercial games and serious games

4.1. Personalized learning in educational games

The primary purpose of serious games is not simply to entertain, but to help players acquire knowledge, develop skills, or understand social issues through rules, feedback, and contextualized experiences. AI can enable educational games to move beyond fixed question banks and standardized feedback toward a more adaptive learning process. By analyzing the types of errors learners make, their response times, and the paths they take through different choices, a system can identify where they are having trouble and provide tiered guidance. For example, a mathematics game could distinguish between conceptual misunderstandings, calculation errors, and

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misinterpretations of a question. A language-learning game could generate dialogue exercises based on a learner's own responses, while a history or social studies game could use controlled role-playing scenarios to help students understand different perspectives.

Although this adaptability may increase engagement, the educational value of such systems must be evaluated through clearly defined learning objectives and outcomes rather than solely through measures such as playtime or click counts. Teachers should not be excluded from the process. A more appropriate approach is for AI to generate exercises and progress reports, while teachers interpret the data, adjust instruction, and address more complex learning needs. In this model, the system provides immediate feedback and varied content, while teachers retain responsibility for educational judgment and for understanding the individual circumstances of their students.

4.2. Applications in healthcare, rehabilitation, and mental health

With regard to healthcare and rehabilitation, AI-driven serious games have been examined for uses-among others-in physical therapy, cognitive training, health education, and behavior modification. Reviews already available seem to confirm their capacity to offer individualized, immersive kinds of training. Nevertheless,most of the current studies are weak in respect of scale ,of validation, or of long-term results. Therefore, one must not confuse technical feasibility with actual clinical effectiveness [4, 5].

Game mechanics may help turn long-term and repetitive training into something involving definite aims, prompt feedback, and gradually increasing rewards, while AI can tailor the difficulty of later tasks-by means of movement or performance indicators. For example, games used in rehabilitation can make use of known sensor data to regulate how much motion is needed, while cognitive-training games can vary difficulty depending on a user 's error patterns. At the same time, such systems must not let AI act autonomously in diagnosing illness, in planning care, or in replacing doctors or therapists. Their correct function is to assist in training, to log observations, and to give advance warnings-without relieving professionals of their duty to evaluate results.

4.3. Public safety, professional training, and the representation of social issues

Training in areas such as firefighting, first aid, nursing, aviation, crisis communication, and business management often involves complex and rapidly changing situations. Traditional training games usually rely on fixed scripts. After repeated use, learners may memorize the "correct answer" without fully understanding the principles behind the decision. Within clearly defined design boundaries, AI can vary character responses, environmental conditions, and the sequence of events, allowing learners to practice decision-making under different levels of pressure and with varying amounts of information. For example, a virtual patient in a first-aid simulation could respond differently depending on the order in which procedures are performed, while a simulated audience in a public communication exercise could show different levels of trust or resistance based on the player's choice of language.

In games addressing cultural heritage, environmental protection, and social issues, AI can also help represent the interests of multiple stakeholders and the long-term consequences of different decisions. An environmental policy simulation, for instance, could demonstrate how a particular policy produces interconnected effects on ecosystems, the economy, and community life. A cultural heritage game could adjust the depth of its explanations according to the player's language and prior knowledge. However, these systems should avoid reducing complex social issues to a single correct answer. Designers need to disclose the assumptions, data sources, and adjustable parameters used by

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the model so that players understand that the simulation's results are generated by a particular set of rules rather than serving as absolute predictions of reality.

4.4. Public safety, professional training, and the representation of social issues

Schools, museums, nonprofits, and research teams generally do not have sufficient means to cover the production costs of full-scale commercial games. AI offers a way to develop early prototypes or instructional content-along with character dialogue, data graphics, or localized texts-which helps lower the barriers to making serious games. Research on personalized serious games has suggested that machine learning and AI may be of value for rehabilitation or for changing behavior. However, the re-use of component systems as well as their evaluation-on a practical level-still need more work [6]. Newer studies of AI-enabled serious games now cite dynamic settings, modeling of the learner, and feedback in real time as promising ideas, but also flag explainability, computational cost, and long-term success as possible limitations [7].

A non-commercial purpose does not automatically eliminate ethical risks. Educational and healthcare games often involve children, patients, or other groups requiring additional protection. Data collection must therefore be transparent, limited to what is necessary, and based on valid consent. System-generated feedback should also be explainable: users should know which judgments are based on automated analysis and should be able to request human review. For features that may affect health, safety, or educational opportunities, development teams should involve teachers, healthcare professionals, researchers, and target users in establishing the system's rules. Because the purpose of serious games is to promote learning, health, and social understanding, AI must serve the well-being of players rather than enable excessive surveillance or behavioral manipulation in the name of personalization.

5. Conclusion

Artificial intelligence is now transforming the available tools and the workflow patterns of game design-yet it need not lead to greater creativity or value for games themselves. In commercial game development, AI helps with prototyping, efficient handling of facts and code, content variety, and broader test coverage. At the same time, it might produce legal complications, alter labor norms, help foster a uniform style of content, or obscure who is accountable for outcomes. Procedural generation, intelligent characters, self-adjusting plots, or tailored systems are all promising ideas-but their use requires control over generation, human checks, data economy, and dependable fallbacks.

The social value of AI may be even more apparent in serious games related to education, medical rehabilitation, public safety, and social issues, as it can support adaptive training, immediate feedback, and low-cost content production. Nevertheless, existing research is still insufficient to demonstrate that all such applications produce reliable long-term outcomes. This is particularly important in high-risk contexts, where technological innovation must develop alongside professional validation and human oversight.

From this point of view, a genuinely sustainable treatment of AI in game design would mean that machines may be used-without restriction-for routine labor, for data analysis, or for limited content repetition, but that human judgment still has to decide upon aims, upon aesthetics, upon feeling, upon ethics, and upon ultimate responsibility. Only with such a division of functions is it possible for AI to grow from an aid to efficiency into a design resource capable of raising both the quality and the social value of games.

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