Indie vs. AAA: A Model for the Educational Potential of Artificial Intelligence in Video Games

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INTRODUCTION

Artificial intelligence (AI) is one of the key technologies of the 21st century and has been widely discussed since the introduction and popularization of generative AI tools such as OpenAI ChatGPT. Video games not only reflect the development of AI but have also played an important role in its popularization. The use of AI in games includes both technological advancements, such as shaping the behavior of non-player characters (NPCs), and procedural content generation of game world objects, such as trees, stones, buildings, and video game levels (Togelius 2019; Yannakakis and Togelius 2018). The successful procedural generation of a given object depends on complex algorithms. The same is true of matchmaking for in-game opponents or analytics (Guzdial et al. 2019; Summerville et al. 2018; Karaca, Derias, and Sarsar 2023). In addition, recent advances in generative AI have strongly affected the game industry (Allison, Luger, and Hofmann 2018). The use of large language models (LLMs) is widely discussed today, mainly due to challenges with production, limitations, and unclear legal situations. For now, the number of games that use such AI is low, and they have been criticized for lack of quality (Dinsdale 2023a; 2023b; Kerr 2024). However, this may change in the future.

In general, AI usually has three areas of application in games: it is used to (1) shape gameplay, (2) create content, and (3) model game properties. Additionally, AI can be implemented in different ways on a given project. First, it can be part of players' experiences as they "interact" with different AI agents. Second, it can help with game production by improving quality or solving problems more effectively than programmers, who must do so manually.

A MODEL FOR THE EDUCATIONAL POTENTIAL OF AI IN VIDEO GAMES

The present paper describes a work-in-progress study on developing a model that highlights the educational potential of AI in video games. This potential refers to three key aspects: (1) how video games can facilitate an understanding of AI principles and applications among players, and (2) how insights from AI implementation in games

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can inform the design of educational games (or games with educational purpose) that effectively leverage AI-based mechanics. Finally, this potential also relates to (3) the importance of implementing AI in video games to overall progress in the AI field.

To explore this, the model (Figure 1) compares two major industry segments: indie and AAA games. While both use AI in varied ways, indie games tend to adopt more experimental and innovative approaches, often allowing players to engage with AI systems more actively. This, in turn, presents unique opportunities for learning about AI through gameplay. The analysis also considers differences in the structure, approach, and philosophy of indie and AAA games and highlights the former's greater educational potential.

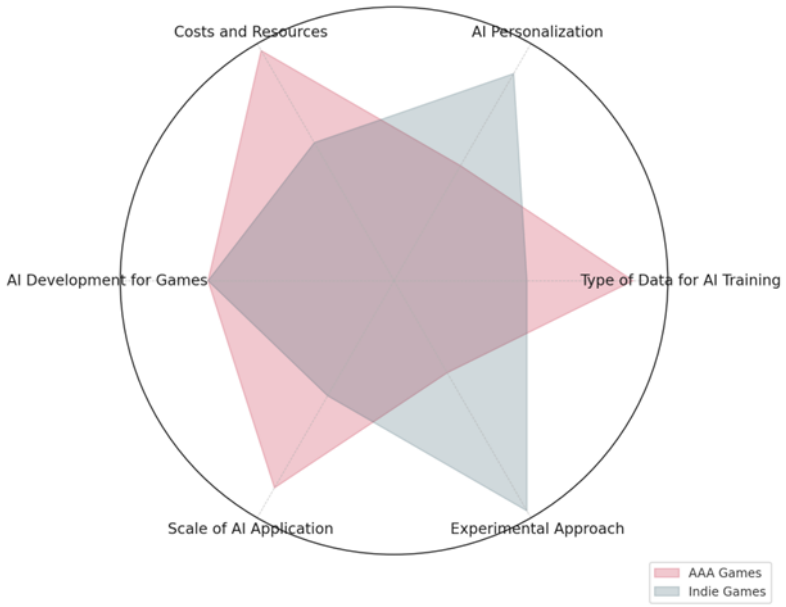

Figure 1: Educational model for the potential of artificial intelligence in video games.

The model reflects six key, interrelated dimensions of how AI is used and developed in video games. First, *Type of Data for AI Training* refers to the quantity and quality of data used to train AI; AAA studios use huge global datasets, while indie games rely on smaller, local datasets. Second, *AI Personalization* describes developers' ability to customize AI solutions. Indie games often introduce more creative, experimental, and engaging approaches than AAA studios, which may lead to a greater understanding of how AI works. An example is the experimental science game *Galactic Arms Race* (Evolutionary Games 2010). Third, *Cost and Resources* addresses the scale of investment in AI development. In this case, AAA games clearly dominate due to large budgets and development teams. Fourth, *AI Development for Games* indicates the overall focus of game companies on AI development; both AAA and indie games seem to be at a similar level, with different approaches to innovation and optimization and willingness to implement different solutions, depending on the publisher or title. Fifth, *Scale of AI Application* shows how widely AI is used. AAA developers and publishers tend to score higher on this dimension due to the global scale of their productions, focus on marketing, and maximization of sales. AAA games often utilize sophisticated AI algorithms that can handle complex game mechanics and large-scale environments (Ontañón et al. 2013). However, it should not be confused with the last category, *Experimental Approach*, which indicates the level of experimentation with AI

solutions. Indie games dominate this category and often propose unique and innovative approaches, which can be technological, gameplay-related, or story-related. Major publishers could be unwilling to implement these approaches due to the high risk of not making enough profits.

DISCUSSION AND CONCLUSIONS

Developed by major studios, AAA games are characterized by high budgets, an emphasis on commercial success, and the use of proven technological and narrative solutions. In these games, AI usually serves as a tool for increasing realism (e.g., advanced NPCs or algorithms that adjust difficulty levels) (Zhang 2023). An example is the "Sophy AI" agent in the racing simulator game *Gran Turismo 7* (Polyphony Digital 2022), which is trained on players' data and utilized to steer racing cars (Wurman et al. 2022). While "Sophy" itself is not directly used for real-life self-driving cars, the techniques developed for it—particularly reinforcement learning and multi-agent training—have significant implications for autonomous vehicles, exemplifying how AI development in games influences progress in the broader field of artificial intelligence (Wurman et al. 2022).

By contrast, thanks to their greater creative freedom and lower production costs, indie games are exploring innovative uses of AI and often focus on gameplay mechanics and narrative experiments. Examples such as *While True: Learn()* (Luden.io 2018), *Spy Party* (aesthetiqore, Chris Hecker 2018), *Vaudeville* (2023 BBS Games AB, Bumblebee Studios), and *Origins* (Inworld AI 2023) highlight indie games' ability to bring AI principles to players through active participation and experimentation. With flexibility and fewer production constraints, indie games introduce innovations that often go beyond the standard schemes used in large-scale productions. Although AAA game developers test many potential AI innovations due to the vast resources at their disposal, they may ultimately be reluctant to implement them since their primary motive is commercial profit. They thus prefer to follow proven schemes (Togelius 2019).

The present article introduces a model that is still being refined and developed, including incorporating more examples of indie games experimenting with AI. This model not only catalogs dimensions of how AI is used and developed but also serves as a roadmap for designing AI-driven educational experiences. The results of the present and future analysis can be used to propose new strategies for developing games that effectively exploit AI's potential. In addition, by identifying the educational advantages of indie games and their innovative approaches to AI implementation, this study highlights the importance of game-based learning in advancing AI literacy.

It is worth noting that Figure 1 provides a comparative visual representation of how different dimensions contribute to the educational potential of AI in video games. However, instead of implying precise quantitative differences, the radar chart (spider diagram) shows the relative strengths of AAA and indie games across six dimensions. The figure does not indicate the absolute superiority of one category over the other but instead highlights relative tendencies.

In addition, the model is developed as a qualitative, conceptual framework that maps key dimensions of AI use in video games. It is a mental model and a heuristic tool constructed based on existing literature, industry analysis, and theoretical considerations rather than direct empirical data collection. Future research will

involve empirical validation, potentially incorporating qualitative case studies of AI-driven games, developer interviews, or quantitative analysis of game mechanics and learning outcomes.

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